The Sewerage of Kansas City.*

BY O. CHANUTE, M. AM. SOC. C. E.

Concluded from page 210.

There seems to be no fact better established than that the large sewers required for occasional floods in the combined system give rise under certain circumstances to exhalations which produce disease. Confirmatory facts must be in possession of nearly all of you, and I did not dwell on the subject in my lecture because the matter seems to be well understood at Kansas City, especially by the physicians, who had already expressed some very positive opinions in published interviews, which more than supported the statements which I made.

Even now that Mr. Moore questions those statements, I will not take up time to accumulate more evidence on this branch of the subject, because after all, the main question is whether the separate system, as improved and carried out at Memphis is, or is not safer, in a sanitary point of view, than the combined system.

Whoever has made an excursion in a combined sewer in time of drought, and observed the slime which covers the walls, the fungous growth to which it gives rise, and the feeble trickling stream meandering around masses of putrefying matter, while breathing the foul air which it generates, will not require much argument as to the offensiveness of large sewers.

But Mr. Moore says "there can be no difference in the amounts evolved from the same quantity of sewage in different sewers," for the reason that, as the length and grade will remain the same, there will be "no material difference in the two cases, either in the velocity of flow or in the quantity of the products of decomposition."

Here we discover the cause for his erroneous conclusion. He has failed to realize that the separate system is daily flushed to nearly its full capacity, while the combined system is only flushed in time of rains. He ignores the most important and meritorious feature first introduced at Memphis, the daily flushing by means of automatic tanks, which completely negatives his assumption that there will be no "difference in the time of exposure."

The volume of gases in a sewer is the result of the decomposition of *deposited and retained matters*, while the amount evolved from the active flow of fresh sewage is trifling; so that the quantity is regulated, not by the amount of flowing sewage, but by the amount of stagnation and deposit. What this may produce in droughty Kansas City, where I have known three spring months to pass without one drop of rain (it made up for it afterward by falling seven measured inches in one night), will probably appear if there be such a drought again.

I am willing to grant that were there no efficient flushing, the house sewage, arrested in the sewers, or smearing their surfaces, and dependent upon an occasional rain storm for its removal, would prove even more dangerous in small pipes than in large ones. The case is entirely changed when that sewage is at once carried to its final outlet by the water from the flushing tanks, when in fact we insure a private rainstorm once or twice a day at the head of every sewer, and so produce a velocity of flow of 2.6 feet per second, as measured in the mains at Memphis.

The instance, therefore, of the outbreak of typhoid fever at Croydon in 1875, proves nothing against the use of small pipes, unless it can be shown that the flushing arrangements spoken of by Mr. Moore as having a close resemblance to the Waring system, were as efficient as those carried out at Memphis in 1880.

To my question as to what these arrangements were, Mr. Moore answers that he does not know exactly, but believes there was some provision by which the water from the town mains could be used. I suppose this depended upon occasional manual working, and unless it is shown that the water was used in flushing quantities once a day I fail to see the resemblance. To my thinking the sanitary advantage of the separate system lies, not in the smallness of the pipes, but in this, that the pipes being small, it then becomes practicable thoroughly to flush them without undue waste of water.

In answer to my further questions, Mr. Moore admits that the combined system would certainly be safer if it were daily flushed to ¼ or ½ of the maximum capacity of the sewers, as is found to be the case at Memphis; but of course we cannot spare sufficient water to flush daily sewers from 5 to 10 feet in diameter, such as are required in some parts of the combined system.

Now let us examine Mr. Moore's criticisms as to the Memphis system proper. He makes the following points:

1st. "That the houses are connected with sewers without the intervention of a trap."

I think that in this Mr. Moore is mistaken, and that this may account for much of his opposition to the Memphis system. As I understand it the main house pipe does connect with the sewer without a trap, but every outlet for waste is separately trapped. That is to say, that the house main, down which all refuse flows, has no outward U bend near the sewer, in which a portion of the water shall remain after every discharge to form a liquid seal against the intrusion of sewer air. It is instead carried up the full size (4 inches) above the roof of the house, and left open, in order to ventilate the sewers, but every water-closet, kitchen-sink, bath-tub and water-sink connects with the 4-inch pipe with a trapped connection of its own.

The air of the sewers is therefore not "laid on" to the houses, and Dr. Buchanan's testimony does not apply to the Waring system, of which, of course, he could know nothing, while the only theory upon which Mr. Moore can claim that sewer air will gain admittance, is that the separate trapped connections are more likely to get out of working order than one main trap next to the sewer.

If this should prove to be the case, if experience at Memphis or elsewhere, should determine that it is better to have one main trap to the house main, I do not see why this may not be done at Kansas City.

2. The sewers at Memphis are only 6 feet deep, and do not drain the cellars.

I believe that in point of fact there are few or no cellars in Memphis, and this may account for this shallow depth. At Leavenworth, however, where there are cellars, the district sewers are from 10 to 16½ feet deep, and I fancy that Col. Waring's patent will not prevent putting them to the same depth at Kansas City.

3rd. The sewers at Memphis were laid crooked.

This is sad if true, but I think I may safely promise on behalf of the people of Kansas City that if Mr. Moore will allow them to adopt a separate system of sewers, they will lay the pipes as straight as ever they can.

4th. The mains were made too small.

Taught by experience, they will be made larger. It is simply a question of carrying off the water from the flush tanks, and from the consumption of the city.

5th. Manholes were omitted.

This, I believe, was an engineering mistake, committed from motives of economy. In fact, when Col. Waring presented a paper upon the Memphis sewers before the Sanitary Institute of Great Britain, the only criticism made by the members present, gentlemen thoroughly familiar with both the combined and separate systems as carried out in England, was that manholes should not have been omitted. I understand that 44 of them have been put in at Memphis by the city authorities, and that they are being put in at Leavenworth. I should advise the people of Kansas City to do the same.

6th. The flush-tanks and systems are patented, and there is a royalty to pay for their use.

This, I imagine, is the real and great merit in the Memphis system, the one which has caused it to be so very severely criticised, and has much delayed its adoption.

Engineers as a rule, myself among the number, do not like to use patented plans. They prefer to make their designs for themselves, to adapt them to each special case by adding, omitting or altering such features as they desire, untrammelled by a patentee; and they resent, as a slur upon their capacity, the intrusion of a cut and dried plan. Others, again, think that Col. Waring should not have patented the system which bears his name, because if it really possesses the great sanitary and economical merits which are claimed for it, no obstacle, such as a patented monopoly, should be interposed to its early and general adoption.

Mr. Moore makes what seems to me a rather unworthy reference to Col. Waring, who is, so far as I know, an honest man, in saying: "Automatic flush tanks of the kind on which Col. Waring controls the patent, were put in liberally." I am informed by Col. Waring that the use of all the flush tanks that might ever be required in connection with the sewerage of Memphis, was licensed for a round sum of $1,000. That of this his own proportion was $250, and that this $250 was credited to the authorities of Memphis, as a part of the payment of his professional fee.

Now, the fact that there are patents outstanding upon the system or some of its parts does not seem to me a good reason to condemn the separate plan, I have not, therefore, thus far troubled myself about the patents, and in fact have never seen them. The first inquiry to be made is whether the separate system, as perfected by the addition of flushing tanks, is the best for Kansas City now to follow. If this should be decided in the affirmative the next question will be whether Col. Waring's patent is valid, and if so, what is the best bargain that can be made with him.

It is very evident we have not got beyond the first inquiry as yet, as the Mayor's proposal, made some months ago, for a committee of investigation has not yet been acted upon. In the meanwhile there are many engineers in various parts of the country who are even now devising different forms of flush tanks and different methods of flushing separate sewers regularly, and it is not impossible that some means shall be found of superseding or avoiding Col. Waring's patents. But even if this cannot be done, the charge will not be an onerous one in proportion to the saving effected. At Leavenworth, for instance, I am informed that the royalties on the work now in progress will be about $1,600, while the saving effected, if we assume that the combined system would have cost there the same per square as at Kansas City would amount to about $90,000. It was stated in the discussion which followed my lecture at Kansas City that, were the separate system to be adopted for such unsewered portions of that city as need early relief, the royalties would amount to some $5,000. I think myself that this estimate is entirely too low; but suppose we quadruple it, and call it $20,000. If it enables us to save spending $350,000 during the next five years, it will still be a notable economy, always assuming, of course, that nobody shall in the meantime improve upon Col. Waring's system, and forbear from patenting the improvement.

These are, I believe, all the objections raised by Mr. Moore to the Memphis system. They are chiefly questions of details which may be

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modified. While there is therefore no doubt in my mind that the combined system is much preferable to no system at all, I submit that the main question is, whether, under the circumstances, it is not preferable for the people of Kansas City, from a sanitary and economical point of view, now to adopt the separate system as improved by the addition of flush tanks, instead of going on with the combined system; whether they are not likely to be as well satisfied with it as are the people of Memphis.

But, says Mr. Moore, if the people of Memphis are satisfied with their separate system (which has cost $6,875 a mile), so are the people of St. Louis satisfied with their combined system (which has cost $30,146 a mile), and so he leads us to infer that one satisfaction offsets the other. Except:—that the people of Memphis ought not to be so much satisfied after all, because while St. Louis has a death rate of 21 per 1,000, the Memphis death rate was 34 per 1,000 in the five years preceding 1880, *omitting yellow fever*, and was, as he figures it, 42.1 in 1881; 30.9 in 1882, and 37.1 in 1883.

Now, in the first place, it seems to me that inasmuch as the sewers of Memphis were especially intended to drain the cess-pools, which formed the hot-bed of yellow fever, a comparison which begins by omitting deaths from this disease (about 5,000 in 1878, out of a population of 40,000, and some 500 in 1879, out of a population reduced to 13,000), is open to some question. This method of reasoning might be extended to the conclusion, that the sewers actually increased the death rate, from an average of 34 in the preceding five years to an amount of 42.1 in the year next succeeding their construction.

But in the second place, I find in the fifth annual report of Dr. G. B. Thornton, President of the Board of Health of Memphis, for the year 1883, the following statements, which seem at strange variance with the facts as alleged by Mr. Moore:

"The increased number of deaths over that of last year is clearly due to an increase of population.

"In computing the death rate per one thousand, I have adopted as the best estimate of the population at my command, the figures of Shole's Directory, compiled in November, 1883. According to it, there are 12 785 white and 5,025 colored names, total 17,810, which multiplied by 3½—the smallest multiple taken in estimating population by a business directory—gives a total population of 62,335. Assuming 35½ per cent. of the total population to be colored, it would give a white death rate of 15.19 per 1,000, and colored rate of 35.83—total, 22.50.

"The report for 1882 showed by a similar estimate of total population a death rate of 24.36.

"Of the 1,403 total deaths for the year 1883, 265 were known to be non-residents, or people who were in the city less than one year, their term of residence varying from a few days to a few months. Many of them were employés of contractors on the railroads, and work of like character near the city. The total deaths in the city hospital for the year were 215, a large majority of which were non-residents, who came to the city seeking hospital treatment.

Dr. Thornton then renews his recommendations of previous years, concerning the amelioration of the water supply which is thought to be contaminated with sewage, the extension of the sewer system, and the draining of Bayou Gayoso, a low-lying district as yet unsewered, where many poor people live, and which is so foul and frequently overflowed, that it is thought that Memphis will not really be safe from a recurrence of yellow fever until it is reclaimed. He winds up his report thus:

"In conclusion I will state that the three essentials to the perfection of the sanitary work of Memphis are: The completion of the sewer system as originally designed, the substitution of Mississippi for Wolf River water, and the treatment of Bayou Gayoso as recommended in Fourth Annual Report. Any other detail connected with the work, however important it may be considered, is but secondary compared with these."

The discrepancy between the figures of Dr. Thornton, and those of Mr. Moore, seems to arise from the fact that the former has estimated the population from his local knowledge, and from the directory, while the latter has estimated that the population increased four per cent per annum, upon the assumption that Memphis ought not to grow any faster than St. Louis. Applied to Kansas City this method of computation would produce strange statistics, but we will assume that the truth as to the death rate lies somewhere between the figures of Mr. Moore and these of Dr. Thornton.

While not disposed any more than Mr. Moore to draw any very rigid conclusions from vital statistics showing such discrepancies and covering so short a period of time, it seems to me that the figures point just the other way than Mr. Moore intends.

What are the facts? The people of Memphis had gone on year after year polluting their soil with cess-pools, just as the people of Kansas City are doing to-day. They had prepared a hot-bed for the development and retention of yellow fever and other diseases, and when the scourge struck them they could not undo in a day the mischief accumulated in years. They did what they could, built 18 miles of sewers and drained part of the ground in 1880, with the gratifying result that the epidemic did not return, but the death rate was still, we will assume in 1881, 42.1 per 1,000, instead of the preceding average of 34, omitting yellow fever. They went on, however, and built more sewers, while those of the previous year continued to drain the ground, and in 1882 the death rate was 30.9, says Mr. Moore, or 24.3 says Dr. Thornton. In 1883 the rate was 37.1, if the population increased no faster than in St. Louis, or 22.5 per 1,000, if it grew as indicated by Dr. Thornton. I submit that this, upon the whole, allowing for accidental causes, seems a satisfactory improvement, particularly when we consider that when the National Board of Health was appealed to by Memphis in 1879 it made some nine or ten recommendations of essential sanitary reforms, of which the sewer system was one, and that the three essentials which Dr. Thornton again and again mentions in his reports yet remain to be executed.

Thus to the three issues, as made by Mr. Moore, I have attempted to make answer as follows:

1st. That storm-water sewers will be a necessity *everywhere* in Kansas City.

I say that Mr. Moore has greatly exaggerated both their advantage and necessity. That in consequence of the peculiarities of its town site, with the 21½ miles of storm-water (combined) sewers it has now, and say 15 miles more of storm-water (separate) sewers, which being at shallow depths, will probably not cost more than $150,000, Kansas City will probably abate all material nuisance from storm-water.

2d. That the combined system will be cheaper that the separate system.

I say that he has not offered a particle of proof in support of this dictum; that we must judge of such matters by the actual results of experience, and that thus far the experience has been just the other way; that the results in many towns in England, and in Lenox, Cumberland Mills, Kalamazoo, Keene, Memphis and Leavenworth in this country, all indicate the separate system to be permanently the cheapest.

3d. That in a sanitary point of view, the combined system is as safe as the separate system.

I say that separate sewers, regularly flushed every day, and in which sewage is at once carried to an outlet with a rapid current, must in such a climate as that of Kansas City be safer than those which depend for their flushing upon an occasional rain-storm. That the data concerning the health of Croydon and Memphis, so laboriously stated, are neither pertinent nor is the reasoning correct; and that notwithstanding the flourish at the end about royalties, and the health and life of the people of Kansas City, I still believe that it will be judicious for them to adopt the separate system.

Frogs and Switches.*

BY W. B. PARSONS, JR., A.B., C.E.

In the matter of maintenance of way there is probably no part so little practically understood by engineers, and often so badly treated theoretically by trackmen, as frogs and switches and their location. Yet really there should be no trouble above the exercise of proper care and attention. In locating the majority of switches there is no need of a transit or any instrumental work, certain writers to the contrary notwithstanding. The only cases where a transit is of service are: first, when the curve of the "lead" is to be continued for some distance beyond the frog; and secondly, where frogs of a very high number are used, whose leads are rather long to be accurately lined by eye.

A switch consists of a frog, lead rails, moving or switch rails, switch gate with its necessary connections, and a set of switch timbers.

Frogs are now known by numbers representing the ratio of length from frog point to heel, to breadth at heel. The old system of letters, which is entirely arbitrary and meaningless, is fortunately rapidly dying out. These letters are AA, A, B, C, and are determined by the following distances from the point to where the frog is six inches across:

AA, 5′ 2″; A, 4′ 0″; B, 3′ 4″; C, 2′ 9″.

For ordinary switches a No. 8 frog will be found the most serviceable, a lower number giving too sharp a curve. For switches at junctions, or where trains pass at high rates of speed, a No. 10 is the lowest number advisable, and even a No. 11 or No. 12 is to be preferred. The frog of the present day is some form of steel rail frog. The rails are either riveted to a wrought-iron plate one-half inch thick, or else are keyed together in a variety of ways according to different makers' views. The choice is a matter of personal preference. There is another form of rail frog which is steadily growing in favor, and already is the standard on the Pennsylvania R. R., N. Y. Elevated Railways, and other roads. This is the spring frog. It undoubtedly possesses great advantages. Inasmuch as one of the wings is always lying close against the point, the wheel tread has a full and unbroken bearing. Thus the point is saved from battering, the frog's life necessary prolonged, and the jar to the rolling stock incident to running over a wornout frog done away with. Of course a spring frog needs more attention to keep it clear and free, especially in winter during periods of ice and snow, but a careful application of the pick and shovel and a little salt will prevent any trouble. As a side remark, let me add here, that immediately after a snow-storm the first thing to be cleared is the switches. Snow and ice should be carefully removed from the head chairs, switch rods and frog, and in fact the snow from the whole switch from frog to further end of moving rails should be entirely removed. Then a little salt sprinkled on the frog and head chairs, around the rods and under the moving rails will prevent the switch from being so frozen as to be useless. Frogs should be made sufficiently long to permit the ordinary angle plates being used at the end joints. There is always more jar at the frog, so special care must be taken to keep it tight in place: and the angle plate firmly bolted and well spiked gives a much more rigid connection between rail and frog than the simple fish plate. For a No. 8 frog an extreme length of ten feet will be found convenient. The old cast-iron frog is rapidly becoming on first-class roads a matter of history, and at the present day has but one suitable place—the scrap heap. Any frog which necessitates the cutting or scoring of the frog timbers is to be avoided.

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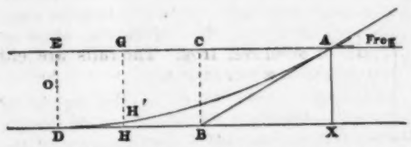
The "lead" of a frog, sometimes called the frog distance, is the distance from a frog point to the head block or toe of the moving rail, measured on the main track rail. The lead depends on frog angle and throw of switch.

The rails of the turnout running from the head block to the frog are sometimes called lead rails. It is this matter of lead that has proved the stumbling block to many an engineer, and given the trackman a splendid chance to display his contempt for "theory" with the natural result of detriment to the switch. Henck (pp. 32 and 33) deduces his formula, which is not only unwieldy but is also incorrect. He bases his investigation on the view that the switch or moving rails are as it were hinged, and so remain straight after being thrown. He then calculates the curve required to join them with the frog; taking the line of the moving rails, after being thrown, as one tangent and the side of the frog prolonged as the other; the point of intersection falling between the rails of the main track. He also talks of the switch angle and a switch rail of arbitrary length. Now in reality the length of the switch rail depends on the frog angle (or frog No.) and throw of the switch, and moreover the rail when thrown does not remain straight, but bends itself in a regular curve, hence there is no "switch angle." Trautwine too, in his "Hand-book for Engineers" (up to the last edition, when he makes correction), was deceived by the same fallacy, and thinks that lead is dependent on length of switch instead of frog angle and throw. Starting with this hypothesis we can calculate the "lead" and length of switch rail required for a given frog angle as follows:



B is point of intersection of side of frog prolonged and main track, the intersection angle *A B X* evidently being equal to given frog angle. The problem is then to join these two tangents with a regular curve.

In triangle A B C having angle C B A = frog angle, C B = gauge, find A C and A B.

Now A B is tangent, or T of required curve and frog angle = I.

Then R′ = T *cot* ½I, will give radius of outside rail, and R = R′ — gauge = radius of curve. Distance A E = E C + C A = T + C A = distance from heel of switch rail to point of frog.

To find length of moving rail, *i. e.*, that portion which should be left unspiked so as to be free to move and carry out the curve, we have to calculate what length of curve is necessary to produce tangent deflection equal to "throw" of the switch rail. This is done by Henck's formula:

$$C^2 = \frac{a \times 50}{\sin D}$$

In which C = length of moving rails required and a = twice the throw (chord deflec. = 2 × tang. deflec.)

The throw is almost universally 5″. This length of moving rail is evidently distance from origin of curve to head block, the latter being denoted in Figure 1 by H G, where H H′ = throw. Therefore A G or lead = A E — E G.

Calculating "T," "R," "lead," etc., for frogs varying by ½ Nos. from 5 to 13, and adding similar deductions for the lettered frogs for sake of comparison we form the following table. The last column gives the distance from head block to point of crotch frog in case of 3-throw switch.

It is better to avoid, if possible, a 3-throw switch. Two frogs abreast of each other are hard to maintain, besides giving a double jar to the passing truck.

FROG TABLE.

No.	Frog Angle.	Tangent Length in feet.	Radius in Feet.	Degree of Curvature.	Length of Moving Rail 5″ throw.	Lead. Head Block to Frog Point.	Total Length of Lead.	H B to Crotch Frog in 3-throw.
5	11° 29′	23.25	234.43	21° 38′	14.02	32.59	46.61	19.09
5½	10 26	25.91	283.83	20 17	15.43	36.00	51.43	20.89
6	9 33	28.26	338.60	16 59	16.85	39.38	56.23	22.97
6½	8 49	30.62	396.87	14 28	18.25	42.69	60.94	24.83
7	8 11	32.97	460.58	12 28	19.66	45.98	65.64	26.80
7½	7 39	35.33	528.75	10 51	21.07	49.43	70.50	28.72
8	7 10	37.68	601.70	9 32	22.48	52.69	75.17	30.64
8½	6 45	40.01	679.80	8 26	23.89	56.14	80.03	32.57
9	6 22	42.39	761.98	7 31	25.30	59.40	84.70	34.49
9½	6 02	44.75	849.06	6 45	26.72	62.65	89.38	36.39
10	5 44	47.10	941.19	6 05	28.11	66.13	94.24	38.35
10½	5 27	49.46	1038.00	5 31	29.51	69.47	98.98	40.29
11	5 13	51.81	1137.75	5 02	30.92	72.47	103.39	42.18
11½	4 59	54.17	1247.02	4 35	32.34	75.97	108.31	44.18
12	4 46	56.52	1355.75	4 14	33.74	79.30	113.04	46.05
12½	4 35	58.88	1470.92	3 54	35.14	82.38	117.52	47.97
13	4 24	61.23	1591.79	3 36	36.56	85.66	122.22	49.74
C	9 45	27.75	325.34	17 40	16.47	38.73	55.20	22.28
B	8 30	31.79	427.79	13 25	18.18	44.35	63.23	25.51
[1]A	7 10	37.68	601.70	9 32	22.48	52.69	75.17	30.64
AA	5 15	51.37	1120.40	5 07	30.59	71.92	102.51	41.45

[1] A frog is same as No. 8.

Now for the moving rails and their connections. The switch gate needs no description and can be passed over with the note that the target should be large and conspicuous and always kept well painted. The moving rails are held together by switch rods; in number at least four, better five. Some roads have them made of flat iron with lugs riveted on to grasp the foot of the rail. But rivets will work loose. Better to have them forged out of square or round iron 1″ to 1½″ in diameter. One of these is close to end of rail and the others distributed back at intervals (if there are 5) of 4 ft. A rod of similar construction, except that one end has an eye, connects switch stand with one of the rails. It is called the "connecting rod," and in order to have the switch gate at proper distance from track, should be 6 ft. long. The moving rails and stub rails come together and are held in place in head chairs, which are best made of malleable iron. The space between the moving and stub rails should be about 1½″, so that when the rails expand they will not bind tight in head chairs. Too great a space produces battering.

The switch, from the frog to the moving rails, rests on special kind of ties or switch timbers. They should invariaby be of first quality white oak, with a face of 8″ and a depth of 6″; to which dimensions they should be accurately sawed with faces at right angles. For a No. 8 frog they are 30 in number, with an additional one called the head block on which the switch gate and head chairs are fastened. This head block should have a face of 12″, a depth of 10″, with a length of 16′ to accommodate gate.

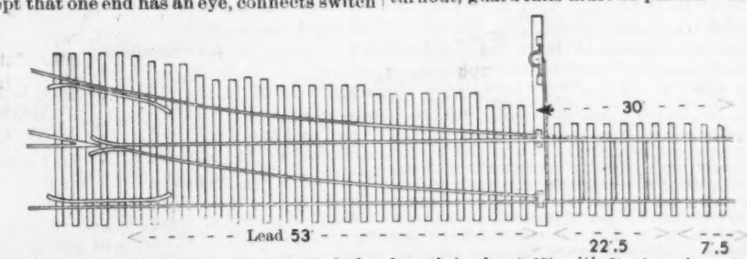
The following bill gives number of pieces with their dimensions:

BILL OF SWITCH TIMBERS FOR NO. 8 FROG—4′ 8½″ GAUGE.

NO. OF PIECES.	DIMENSIONS.	LINEAL FEET.	FEET "B.M."
3	9′ × 8″ × 6″	27	108
7	10 × 8 × 6	70	280
6	11 × 8 × 6	66	264
5	12 × 8 × 6	60	240
4	13 × 8 × 6	52	208
5	14 × 8 × 6	70	280
30		345	1,380
1 Head Block	16′ × 12″ × 10″	16	160

This set will answer for frog Nos. 7½ and 8½ as well as for No. 8. For higher or lower numbers slight and obvious changes are necessary.

Now comes the matter of locating switch and putting the above parts together. As a rule, the location of either head block or frog is fixed by some arbitrary or practical conditions, but in case where variation of a few feet can be allowed it is best to select some joint for either one end of the frog or for the toe of the moving rail. This saves one cutting of a rail. Having thus determined where the point is to come, we simply measure back the length of the lead as given in the seventh column of our table and obtain location of the head block. With that in position, the remaining ties are put in order at intervals of about 24 inches centre to centre, with the shorter timbers next to the head block. That permits 3 or 4 ties to be placed beyond frog point. The ends of the switch ties should be carefully lined on main track side so that gradual increase of length will serve on turnout side to accommodate curve. Now put in the frog. Inasmuch as it very rarely occurs to have two 30 ft. rails with their joints exactly opposite for moving rails it will generally be necessary to tear up main track and cut some rail so that two 30 ft. rails can be placed opposite each other for our moving rails. These (for a No. 8 frog), must be spiked for a distance of 7′.5 from the heel. The remaining 22′.5 are held together by the five switch rods previously described. With our frog and moving rails in position it is an easy matter to lay the lead and guard rails, put up the switch gate, and our switch is finished. Opposite the frog, on both main track and turnout, guard rails must be placed. The best length is about 15′ with 2′ at each end curved outwards from rail. Between the guard rail and main rail there should be a space of 2″. Anything in excess of this will give a pair of wheels that chance to be wide gauge an opportunity to mount the frog point; and if the space is more than ¼″ less than 2″ the wheel flanges will rub. To obtain this distance of 2″ the guard rail flange must be trimmed off ¼″, for unless this is done the spikes between guard and main rail will separate them at least 2¼″. Guard rails should not only be thoroughly spiked, but also have suitable braces on exterior to hold them firmly in position. Defective guard rails are frequent causes of derailments. The above arrangement can be more easily understood by referring to the annexed diagram.



Particular attention should be paid to the solid tamping of switch ties. The frog, and especially the lead rails, should be carefully lined, and in these points a track foreman can show his excellence. Many trackmen claim that the leads as given in the table are too short for practical purposes. This is not so, for if the lead is lengthened it is impossible to get a good line, an "elbow" being sure to occur between frog and head chair, and moreover when the moving rails are thrown for the side track the lead rails will not carry out the regular curve.

Mention was made above of spiking moving rails for a distance of 7.5′ in case of No. 8 frogs. Reference to our table will explain this. The lead of a No. 8 frog is seen to be 52.69′. Now that is from the theoretical point, but the actual point of the frog is blunt, being as a rule ½″ wide, hence in measuring from the

actual point we must add ¼" × frog No., or 4" for a No. 8 frog, to one lead length. So we get the convenient figure of 53 for the lead distance, *actual* point to head block. Again we see that the total length of curve is 75.17 and length of moving rail required 22.48', these become 75.5' and 22.5' by adding our 4' and taking convenient approximate numbers. So we have 22.5' of moving rail unspiked, and with a 30' rail 7.5' spiked. One should carefully distinguish between theoretical and actual points, as calculations are based on former and measurements in practice on latter.

In cases where a transit is to be used, it must be set up at origin of our lead curve (point O, Fig. 1) and lay off curve corresponding to frog with stakes at least every 25 ft. Then frog point will be in advance of this the number of feet taken from column 8 in our table; when the other distances can be measured back as before. So much for the ordinary "stub" switch. But on main lines, or where trains pass rapidly, the stub switch is an element of danger through misplacement, and our prominent roads have adopted some one of the patent safety switches for their standard. The principle of calculating lead, radii, etc., are of course similar to those of the stub switch, bearing in mind that in case of "point" switches the lead is the total distance as given in column 8, and means the measurement from frog point to switch point. The safety switches in most general use in this country are the Wharton, the Lorenz, and the Tracy. The first-named has the advantage of giving an unbroken main track, the wheels being carried over the rails. It has the advantage, however, of great weight and multiplicity of parts. The Lorenz is a "point" switch, and gives one main track rail unbroken. It is simpler than the Wharton, but has two serious disadvantages. Inasmuch as there are springs between the points, a derailment is almost sure to destroy them, or if ice and gravel get between point and main rail the target on the switch gate can be thrown to safety while the "point" has not moved, the lost motion being taken up by the springs. On a similar principle to the Lorenz is the Tracy, and I think the superior to them all. The spring is located in the switch gate and by an ingenious device the target cannot be thrown unless the point is securely in place. Its parts are few and in case of breakage can easily be duplicated at the R. R. Co.'s shops.

By Rail to South America.

WASHINGTON, May 5.—In compliance with an order of the House Committee on Foreign Affairs, Representative Stewart of Texas, has prepared a bill providing for the appointment of three Commissioners, to serve two years, to aid in extending American trade and commerce, and in acquiring information looking to railway communications between Southern countries and the United States. The bill provides that the Commission shall visit Mexico, Guatemala, Honduras, Salvador, Nicaragua, Costa Rica, Colombia, Venezuela, Ecuador, Peru, Bolivia, the Argentine Republic, Chili, Uruguay, Paraguay, and Brazil. The bill appropriates $70,000 to pay the expenses of the Commissioners and their salaries of $5,000 each annually.

In his report to accompany the bill Mr. Stewart says:

"The idea of building a railway from the United States to the Argentine Republic is somewhat startling to those who have never given the subject a thought, but there is no insuperable obstacle in the way of such an enterprise. A railroad connecting with the railroad system of the United States to the City of Mexico, and thence through Central America and along the Isthmus of Darien, passing east of the Andes, through South America to the Argentine Republic, would meet with but few natural obstacles, and the distance would not exceed 6,800 miles, and it may be shortened to 6,000 miles by commencing its construction at the City of Mexico, where it will connect with roads already built. It is believed that the obstacles to the completion of such a road are no more formidable than were those encountered twenty years ago in the construction of our first transcontinental line. When such a railroad is constructed our commerce will be enlarged to such an extent as at this time to defy anything like a correct estimate of its value.

RURAL WATER SUPPLY.

BY CHARLES L. HETT, ASSOC. MEM. INST. C. E.

III.

WATER POWER PUMPING MACHINERY.

Water power when it can be obtained is, perhaps, the most satisfactory agency which can be employed for pumping.

Assuming that a fall is available, it only remains to be determined what is the most suitable means of utilizing it. Amateur engineers frequently settle this point in a very off-hand manner, and decide upon a ram, wheel-pump, or turbine, simply because they happen to know of one that has answered when erected in their neighborhood. It is almost impossible to convince an amateur that what has proved satisfactory in one case is not necessarily the best for another, where the conditions are totally different. The same obstinacy will be found in some of the smaller makers of pumping machinery, who only construct one particular class of water raiser. They are not unnaturally inclined to give it the preference in every case, rather than try something else, of which they have had little or no experience, although it might be very much better adapted to the situation.

If the water is furnished by a well or spring on a hillside, a hydraulic ram will generally be found to be the most suitable. On the other hand, in cases where a stream furnished the motive power, a little judgment is required before deciding on the means to be employed. It frequently happens that the balance of advantages is in favor of a pumping water wheel. This machine possesses the power of drawing the supply to be raised from a shallow well, into which the water filters through the sub-soil, or a bed of gravel interposed for that purpose. This removes the turbidity which is always to be observed in streams after rain. The pumping ram has the same advantage, but the writer prefers the wheel when the water at command is sufficient, as it is more simple and generally understood. Our illustration represents a standard wheel of the type adopted in our own practice. It is three feet diameter, one foot wide, and is cast complete in a single piece, and afterwards galvanized. A fall of four feet six inches is required, and at least one hundred gallons of water per minute for motive power. The pumps are generally of the piston and plunger type, which possess all the advantages of double action, while only two valves are required for each pump. The above table gives the sizes of the pumps employed under different lifts and the quantity of water raised.

Lift in feet.	Size of Pump.	Gallons of Water raised per 24 hours.
200	One 2 inch	700
150	" 2 "	1000
100	" 2¼ "	1500
50	Two 2 "	2000

For larger works, such as the supply of villages, we have applied wheels of six feet six inches and ten feet diameter respectively, the former being cast in two and the latter in three parts, but it is seldom that anything larger than three feet is required.

In a great number of cases where a ram or wheel-pump might advantageously be employed, its use is thought impracticable on the ground that a dam is not admissible in the only stream available for working it. In such instances the difficulty is easily overcome by carrying the water alongside the stream, in an open channel, or in sanitary pipes. The machine may be placed anywhere in the length of the channel which would be the most convenient.

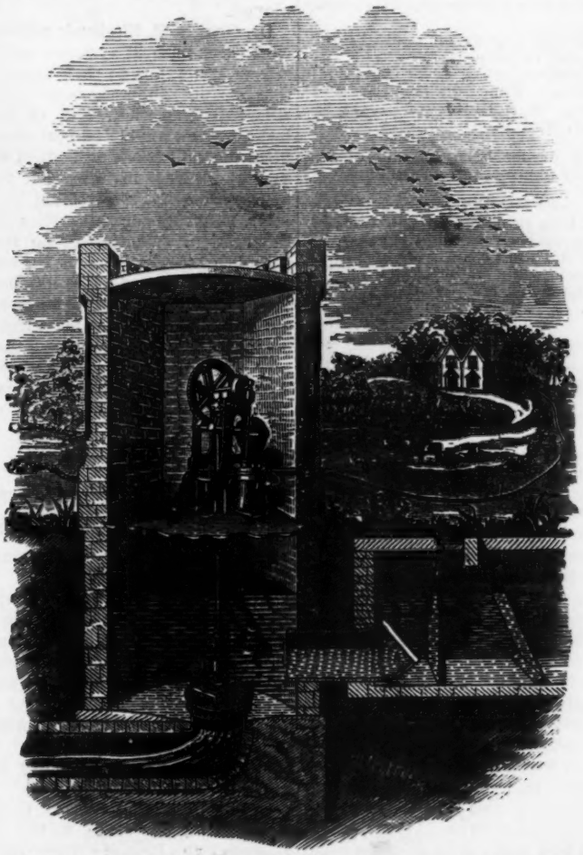
The accompanying sketch represents such a side drain which was cut to obtain a fall for working a ram to supply water to a mansion. In this case the position of the hall made it necessary that the ram should be placed near to the intake from the stream; but where circumstances will permit, it is better placed lower down, as the channel has not then to be excavated so deep.

Turbines and pumps are more expensive than wheels, but they are unrivalled for use on streams subject to heavy freshets. For illustration we have chosen an arrangement erected for the Midland Railroad Company, at Blackwell Mill, near Buxton: in this case two hundred gallons per hour were required,

three hundred guaranteed, and four hundred and eighty actually delivered.

HYDRAULIC RAMS.

Supposing that a ram is decided upon, the following points should be observed in its selection. It is a matter of great importance that the ram should be capable of a high duty, that is to say, that it will, with a given lift, fall and quantity of water, raise the greatest practical percentage of the supply. The theoretical quantity which an absolutely perfect machine would raise is ascertained by multiplying the quantity at command by the fall, and dividing by the lift. The proportion which the quantity actually raised bears to the



theoretical quantity, is called the percentage of useful effect. The following table, deduced from Eytelwein's experiments, gives the percentage of useful effect to be expected with various proportions of lift to fall:

Lift to Fall.	Useful Effect.	Constant.	Lift to Fall.	Useful Effect.	Constant.
4	.86	310	15	.34	32
5	.79	227	16	.30	27
6	.73	175	17	.27	23
7	.68	140	18	.23	18
8	.63	113	19	.20	15
9	.58	93	20	.17	12
10	.53	76	21	.14	9.6
11	.49	64	22	.11	7
12	.45	54	23	.08	5
13	.41	45	24	.05	3
14	.37	38	25	.02	1
			26	.00	0

It will thus be seen that the useful effect decreases with proportion of lift to fall, and when the lift becomes twenty-six times the fall, no delay can be expected. We have found this table generally to agree with experiments.

If the water at command is multiplied by that contained opposite the Lift to Fall, the result obtained is the quantity of water in gallons received per twenty-four hours and the corresponding useful effect.

But to return to the application of the ram. For falls exceeding ten feet, and lifts up to one hundred feet, almost any ram of the American type will answer.

Great inconvenience and much annoyance will be avoided by erecting a properly designed ram. The supply may run short with an inefficient one, while enough water is running to waste through the machine to keep one of proper construction in constant action. It is important also, as a matter of convenience, that the delivery valve should be accessible for adjustment or replacement without disturbing the pipes. If this is properly arranged, an unskilled hand can remove, examine and replace either of the valves in a very short space of time, thus avoiding the expense of bringing a mechanic from a distance. The size of the ram must be decided after considering the quantity of water at command and that required for consumption, together with the fall and lift. The measurement of the supply in the stream may be accomplished by the methods described in Article No. I.

The necessary data being obtained, the usual course to be pursued is to estimate the quantity of water required to be raised, then (the fall and lift being known) the size of the ram needed to deliver that quantity can be ascertained from a book of Tables.

MR. ANDREW CLERK, of Jersey City, who has interested himself in the subject of a purer and better supply of water for Jersey City than that which it now receives, has submitted a proposition to the Jersey City Board of Works. He proposes to extend a wrought-iron pipe, taking the water from some three miles above the Jersey City intake, at a point where Prof. A. R. Leeds says the water is the purest, this pipe to be discharged into a well about 25 feet square and 15 to 16 feet deep below high water, to be water tight against the river water, from this well the different pumps will draw their water for the supply of Jersey City. Mr. Clerk estimates the cost of this improvement will be about $140,000.

THE Brazilian Government has just spent $10,000,000 upon the new water supply of Rio.

American Society of Civil Engineers.

ANNUAL CONVENTION OF 1884.

EXCURSION:

NEW YORK TO BUFFALO AND RETURN,

TENDERED BY THE

NEW YORK, WEST SHORE & BUFFALO RAILWAY COMPANY.

THROUGH E. L. CORTHELL,

M. Am. Soc. C. E., Chief Engineer N. Y., W. S. & B. R'y.

ANNOUNCEMENT.

THE EXCURSION WILL LEAVE NEW YORK

ON MONDAY MORNING, JUNE 9TH, 1884, AT EIGHT O'CLOCK, SHARP, (8 A. M.)

FROM THE ERIE RAILWAY SLIP,

FOOT OF WEST 23RD STREET.

THENCE BY BOAT TO WEEHAWKEN (N. J.) PASSENGER STATION. TRAIN WILL LEAVE WEEHAWKEN PASSENGER STATION AT 8.30 A. M.

It will be necessary for the party to be on hand *promptly at the hours named*, as the train, which is special, must leave *absolutely on time*. Baggage can be taken on the same boat. Stops will be made at certain points of interest. Lunch at Kingston. Dinner at Syracuse. Arrive at Buffalo early in the evening.

The train will have all arrangements for the comfortable accommodation of members and guests and ladies accompanying.

Returning, the special train will leave Buffalo Saturday morning, June 14th, arriving in New York the same evening.

REPLY BY BLANK ACCOMPANYING

is requisite at as *early a date as possible*, to enable the officers of the N. Y., W. S. & B. R'y to make suitable arrangements for the special train.

The Annual Convention of this Society for the year 1884 will be held at Buffalo, N. Y., beginning June 10th, 1884. Sessions for professional discussion and one for the transaction of business will be held.

The arrangements are in charge of a committee of gentlemen residing at Buffalo, in consultation with the Members of the Society at that city, and with the Board of Direction.

The meetings of the Convention will be held at the Hall of the Young Men's Christian Association, at the corner of Pearl and Mohawk streets.

The first meeting will be on Tuesday morning, June 10th, at 10 A. M.

On the evening of the same day there will be a public meeting, at which the Convention will be welcomed to Buffalo by the Mayor of the City, the President of the Common Council, and the President of the Merchants' Exchange. The President of the Society, D. J. Whittemore, Esq., will reply, and will deliver the annual address.

Meetings will be held on the days following, and it is expected that the exercises of the Convention will close on Friday evening, June 13th.

Arrangements are in progress for visits to points of interest in and near the city. There will also be one day spent at Niagara Falls. Social receptions also will occur.

Arrangements have been made by the Committee for the accommodation of the visitors to the Convention and their families at the Genessee House, the Tifft House and the Mansion House.

It will probably not be possible to accommodate all the visitors at any one of these hotels, but they are all within a short walk of the place of meeting.

The headquarters of the Society will be at the Hall of the Young Men's Christian Association.

As will be seen by the accompanying letter from E. L. Corthell, Esq., M. Am. Soc. C. E., Chief Engineer New York, West Shore and Buffalo Railway, the members of the Society who can make it convenient to do so, are invited to go to and from the Convention in a special train over that road. It will leave New York at an early hour on Monday, June 9th, and arrive in Buffalo early in the evening of that day.

Arrangements for the transportation of visitors to the Convention from other points will be made as far as practicable, and will be announced to those who reply by the enclosed blank.

Members of the Society are invited to transmit to the Secretary papers that they are willing to present at this Convention, in order that a place may be given for them in the programme.

NEW YORK WEST SHORE & BUFFALO RAILWAY COMPANY.

WEEHAWKEN, N. J., April 8th, 1884.

To the Members of the
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Gentlemen:

Recollecting with much pleasure the excursion which I had in charge in 1877, at the time you visited the South Pass Jetties, at the mouth of the Mississippi River, it now gives me great pleasure to invite you, in behalf of the officers of the New York, West Shore and Buffalo Railway Co. and the New York, Ontario and Western Railway Co., to take part in an excursion over these railways to and from the Annual Convention to be held at Buffalo in June next.

There will be several works of great interest to be seen, and many pleasant views, and there also will be opportunities for inspecting the West Shore Road. Your convenience and comfort, as well as that of your families (who are most cordially invited to accompany you), will be anticipated.

Hoping to see a large number on this excursion,
I remain, very truly yours
E. L. CORTHELL,
Chief Engineer,
N. Y., W. S. & B. R'y Co.

The titles of papers published in Transactions since the last Convention, or in preparation for publication, and upon which discussion is invited, are given below.

Members are particularly desired to take part in discussion upon any of the subject presented, either by these papers of the past year or by new papers. Members are also requested to present papers upon other subjects.

PAPERS PUBLISHED DURING THE PAST YEAR.

CCLVIII. (*June.*) How can Railways be made more efficient in the transportation of Freight: William P. Shinn.

CCLX. (*July*). Geodetic Field Work: George Y. Wisner.

CCLXI. (*August*). On the Current-Meter: together with a Reason why the Maximum Velocity of Water Flowing in Open Channels is Below the Surface: F. P. Stearns.

CCLXII. (*August.*) Discussion on the Increased efficiency of Railways for the transportation of Freight: By Charles Douglas Fox.

——(*August*). Regulations of the English Board of Trade for the Construction and Working of Railways.

CCLXIII. (*September*). Rebuilding of the Monongahela Bridge, at Pittsburgh, Pa.: G. Lindenthal.

——(*September*). Discussion on Rebuilding the Monongahela Bridge: By F. Collingwood, T. Egleston, and G. Lindenthal.

CCLXIV. (*October*). The Preservation of the Falls of St. Anthony: Francis U. Farquhar.

——(*October*). Discussion on the Preservation of the Falls of St. Anthony: By Charles T. Allen, Charles E. Emery, Francis U. Farquhar, C. G. Force, P. A. Peterson, F. Collingwood, Charles Hermany, and J. James R. Croes.

CCLXV. (*October.*) The Water Power of the Falls of St. Anthony: Joseph P. Frizell.

——(*October*). Discussion on the Water Power of the Falls of St. Anthony: By N. M. Edwards.

CCLXVI. (*November*). The Cost of Steam Power: Chas. E. Emery.

——(*November*). Discussion on the Cost of Steam Power: By James B. Francis, E. D. Meier, J. F. Holloway, Charles E. Emery, and Joseph P. Frizell.

CCLXVII. (*November*). The Shubenacadie Canal: E. H. Keating.

CCLXVIII. (*November*). The Nasmyth Pile Driver: Don J. Whittemore.

CCLXIX. (*November*). Vibration, or the Effect of passing Trains on Iron Bridges, Masonry and other Structures: James L. Randolph.

——(*November*). Discussion on Vibration, or the Effect of Passing Trains on Iron Bridges, Masonry and other Structures: By Theodore Cooper and Charles E. Emery.

CCLXX. (*November*). On an Economical and Efficient Bridge Floor: W. Howard White.

CCLXXI. (*December*). General Suggestions as to the Conditions proper to be Required in ordinary Iron Highway Bridge Construction: J. A. L. Waddell.

CCLXXII. (*January*, 1884). Metrological Investigations: O. E. Michaelis.

CCLXXIII. (*January*). Recent Dredging Operations at Oakland Harbor, Cal.: L. J. Le Conte.

CCLXXIV. (*February*). Water Power with High Pressures, and Wrought iron Water Pipe: Hamilton Smith, Jr.

——(*February*). Discussion on Water Power with High Pressures, and Wrought-iron Water Pipe: By William R. Hutton, A. H. Emery, E. B. Dorsey, F. O. Norton, F. Collingwood, Theodore Cooper, A. Fteley, Charles E. Emery, William H. Paine, George S. Greene, Jr., and Hamilton Smith, Jr.

CCLXXV. (*February*). Structural Steel: E. B. Dorsey.

——(*February*). Discussion on Structural Steel: By F. Collingwood, Theodore Cooper, M. N. Forney, and E. B. Dorsey.

CCLXXVI. (*March*). Preliminary Report of the Committee on a Uniform System for Tests of Cements.

——(*March*). Discussion on System for Tests of Cements: By D. J. Whittemore, Eliot C. Clarke, F. Collingwood, J. J. R. Croes, and J. Albert Monroe.

CCLXXVII. (*March*). Railway Pile and Pontoon Bridge at Prarie du Chien, Wis.: John Lawler.

——(*March*). Discussion on Railway Pile and Pontoon Bridges: By William P. Shinn, D. J. Whittemore and John Lawler.

CCLXXVIII. (*March*). The Temperature of Water at various Depths in Lakes and Oceans: Hamilton Smith, Jr.

CCLXXIX. (*April*). Experiments on the Strength of Wrought-iron Struts; James Christie.

The following papers, not yet published, are also open for discussion. Proof slips of these will be prepared for issue at the Convention.

The proper Compensation for Railroad Curves upon Grades: W. R. Morley, with discussion by a number of members of the Society.

Cranes as Labor-Saving Machines: Charles J. Appleby.

Chimney Construction, with Descriptions of several high Chimneys.

The Comparative Liability to and Danger from Conflagrations in London and in American cities: E. B. Dorsey.

Descriptions of a Combined Triangular and Suspension Bridge Truss and Comparison of its Cost with that of the Warren, Pratt, Whipple and Howe Trusses: Edwin Thacher.

The Strength and Elasticity of Structural Steel, and its efficiency in the form of Beams and Struts: James Christie.

It is expected that papers on several interesting subjects will be presented.

Reports will be expected from the Committees on Standard Time; on the Preservation of Timber; on a Uniform System for Tests of Cement, and those subjects will be discussed.

Discussion is requested upon any of the above subjects by members who cannot attend the Convention.

The Secretary will be glad to present these if forwarded to him previous to the Convention. It is particularly requested that papers offered for presentation at the Convention be sent to the Secretary not later than June 1st, so that proper attention may be given the subjects presented.

JOHN BOGART,
Secretary Am. Soc. C. E.

May 1st, 1884.

Disposal of Sewage.

A discussion on sewage system took place recently at the special meeting of the Suffolk District Medical Society (section for clinical medicine, pathology and hygiene), and various opinions were presented as to the best methods.

Dr. H. J. Barnes opened the discussion by reading a paper advocating the epuration of sewage by irrigation and agriculture. He began by saying: "The present methods of gathering in cesspools or subterranean channels which discharge in a manner to jeopardize the health and comfort must be abandoned for a system which shall dispose of and purify the sewage in a practical manner, or we must give up some of our large rivers for sewerage systems, or construct at enormous expense metropolitan systems, both of which have proved unsatisfactory or failures in Europe." Dr. Barnes then stated that every year in Massachusetts there were 10,000 cases of typhoid fever, and it could be judged how many of those cases came from imperfect sewage. One of the most common methods of depositing sewage is by cesspools, a method which generates dangerous gases and vitiates subsoil water. After long experience scientific men have declared that the only way to epurate sewage is to send it on the land. Dantzic has a sewage farm, having emptied its refuse upon a barren, sandy island, which has since turned by this process into a fertile farm. Other cities and towns of Europe have improved their lands in the same way. The highly satisfactory operation of this system at Dantzic, where the vigorous climate of winter is as great an obstacle to overcome as here in Masschusetts, is sufficient proof that frost is not an objection to its employment on an impoverished soil. The land freezes four feet at Mantzic, Vistula is frozen over from the middle of November to March, yet the temperature of the sewage at the mouth of the sewer never goes below 37 Fahrenheit. Irrigation is continued throughout the year with quite as much success in epuration in winter as in summer, although vegetation flourished but four out of the twelve months. There must be abundance of land in the valleys of the Blackstone, the Merrimack and Connecticut suitable for farms of this character. There is land bordering on Lake Cochituate well adapted to farming for the protection of the lake from the sewage of Pegan Brook. In Arlington, Belmont and Medford are vegetable farms favorably located and soil well suited to this system. And before this community embarks in a scheme to build a metropolitan sewer from Natick to tide water which, when finished, will be of doubtful utility, judging from the experience of London, this system should be tested with the object of requiring each and every community to take care of its own sewage. We have in the soil a chemical laboratory, a perfect filter, oxidation, vegetation, the influences of animal life, and the infusoria, combining to protect the subsoil water, and so far as experience goes or chemical analysis can demonstrate, it is sufficient when all these processes of nature are employed.

Dr. George B. Shattuck affirmed that there were three natural systems, carrying by large sewers, pumping to tide water, and turning into rivers. Then there were the systems of chemical epuration, and of irrigation; the latter system having two processes, downward filtration and broad irrigation with reference to agriculture. Dr. Shattuck then discussed briefly some of these systems.

Mr. E. W. Bowditch touches on a few points in question. Whether or no sewage farming pays is a local matter, for the sewage, climate and market are of different character in different localities. It may be doubted whether irrigation is possible as far north as this. The disposal of sewage in Massachusetts is coming now into notice. A metropolitan system seemed impossibly, but perhaps some simple system of filtering could be devised to help the matter.

Dr. H. P. Walcott, Secretary of the State Board of Health, followed. He thought we didn't know enough about the matter here, as yet, to say how much of the sewage would disappear by evaporation. He looked forward with confidence to the experiments to come at the Concord prison.

Dr. S. H. Durgin, chairman of the Board of Health, considered that Boston was not so situated that sewage could be passed to land and utilized by irrigation; the climate was not suited. Boston was, however, well situated for emptying sewage into the ocean.

Mr. A. H. French, Town Engineer of Brookline, thought that the peculiar topography of this section was a difficulty to agriculture sewage.

Dr. J. G. Blake, Water Commissioner of Boston and physician to the City Hospital, regarded the Boston system of sewage as an admirable one, and thought if the adjoining towns could be united with it that it would be of advantage. It had been decided to test again the method of filtration, and then endeavor to test the sewage in relation to agriculture.

Mr. Charles F. Folsom, ex-Secretary of the State Board of Health, held that the system proposed by Dr. Barnes was not possible for Boston, though it might be for Natick.

Col. Wilson of South Boston said it must be remembered that what would do in Paris and other places abroad would not do here; we are not an irrigating people, and this is not an irrigating soil or climate.

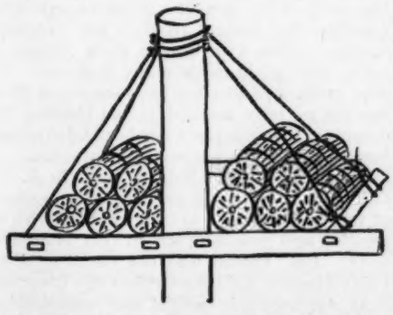
The Judson Powder Co. have issued a well-illustrated circular, showing the adaptability of their powder to the removal of stumps, trees and boulders, showing the size of crater made by different charges, and the best method of applying the cartridge. A price list, and testimonials of use, form part of the circular.

THE Aqueduct Commission on the 7th, formally adopted the route from Pocantico to the Croton dam, which it had already approved, and took up the subject of the letting of the contracts for the work. Nothing was done concerning the contracts except to discuss them.

Pile-driving in Japan.

The method usually employed and original to Japanese is one called *Tako-tsuki*. In this method a temporary framework called *Ashi-shiro* is built with round timbers and ropes in the place where the piles are to be driven. The height of this framework varies with the lengths of the piles. The ram called *Tako*, Fig. 1, consists of a log of wood from 6 to 8 feet long and 6 to 10 inches in diameter, with two long legs, or rather handles, attached to it on the upper end, placed opposite to each other. To prevent the cracking of the ram, an iron ring is put on the lower end, and many bamboo rings at the intermediate positions. The number of workmen employed varies from 8 to 20 according to the sizes of the piles and rams.

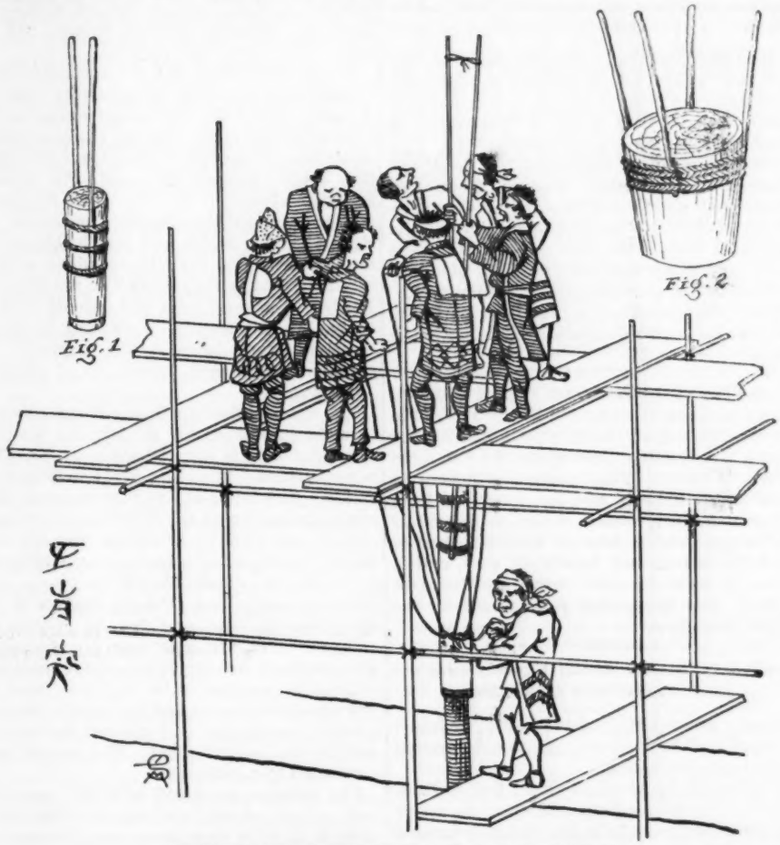
The manner of driving piles will be seen from the sketch. The workman on the frame-



work pull or lift up the ram while one of them holds the legs and guides the motion of the ram, thereby adding some force to it. There is also one at the bottom who guides the motion on its descent, pulling the ram downward and thus directing it true on the top of the pile. Sometimes there are two guides at the bottom.

In the large ram there is only one leg projecting from the center of the log, for in this case, the person holding the leg can add no force but only guide the motion of the ram.

In driving small piles where it is inconvenient to build a framework, one called *Sakadako* is used. This consists of a round piece of wood (fig. 2), its diameter varying from 10 to about 16 inches, and length from 1 to 2 feet, with four legs attached to it. In driving piles by this, the ram is used upside down while men cannot reach the top of the piles. As the top of the piles become low, the ram is turned right side down and worked in the usual way. This seems to be a later invention.



PILE DRIVING IN JAPAN.

In sandy bed of rivers and like places, the piles are driven by hanging heavy weights to them and moving them back and forth slowly, as shown on the accompanying sketch.

At present various kinds of pile engines are used but most of them are imports from other countries, and others are modifications of them, so that the pile-driving original to Japanese are only those mentioned above.

The foregoing description was written by a Japanese Engineer, who also prepared the drawings accompanying it. Prof. Waddell, of the University of Tokio, supplements the description of the method of driving as follows:

"When all hands are in the position shown in the picture, the leader starts up a song which he continues for three or four minutes, winding up with a diabolical yell, in which all join with such a will that their united screech can be heard half a mile away; then, all pulling together raise the weight a few feet and let it fall. Then the leader pipes up again, and so on until the pile is driven. It is needless to say that pile-driving, like nearly every kind of work in Japan, is rather expensive."

THE Salem, Mass., Water-Works pumped 55,291,600 gallons of water into the reservoir in April in 228 hours 40 minutes actual pumping; consuming 54 tons 1110 pounds of coal, and raising 455 gallons per ponnd of coal. The total rain fall for the month at Wenham Lake was 5.52 inches against 2.48 inches in April, 1883.

THE Boston Water Board announced on the 1st, no more applicants would be received for employment.

SELECTED MISCELLANY.

CANADA'S financial credit during the current year will be pledged to the enormous extent of $55,000,000, all of which, it is expected, will be raised at 4 per cent. The total amount added to the permanent debt of the Dominion, during the present marvellous session of Parliament, includes the following amounts: For the Canadian Pacific, $30,000,000; Vancouver's Island Railway, $750,000; settlement of provincial debts, $4,000,000; new railway subsidies, $9,000,000. The amount stated in the supplementary estimates was $1,379,000.

THE United States is the only government which imposes no burden on commerce for the support of the lighthouse and buoy system. At present there are over 700 lighthouses on the American coasts and rivers, and also twenty-five floating-light stations, the total annual expenses being $1,889,017. In addition to the above there are nearly 6000 buoys and beacons, which mark danger of less threatening character.

THE narrowest house in New York is 251 William Street, near New Chambers Street. It is three stories high and not quite six feet wide. It is of red brick. A shoemaker occupies the lower floor, and has to seat himself exactly equidistant from the sides to prevent the rasping of his elbows by the walls whenever he makes a stitch. There is, of course, no room for a staircase, and persons entering the house must either go through the shoe shop or by doors leading in from the adjoining houses.

IT was a chance remark at a gun trial in France that gave Henry Bessemer the idea of improving and strengthening gun metal. He incurred an immense outlay. He built furnace after furnace, he tried machine after machine, he took out patent after patent and he saw the money he had amassed by previous inventions fast melting away. After sundry partial successes he fell into disrepute and was being sneered at by the iron manufacturers as an unpractical enthusiast while the Woolwich authorities had been snubbing him as a matter of course. A few months later Bessemer had produced steel worth from £50 to £80 per ton from iron that cost him only £7. "He could then see in his mind's eye, at a glance, the great iron industry of the world crumbling away under the irresistible force of the facts so recently elicited." "Fourteen years afterward these experimental works were sold for exactly twenty-four times the whole subscribed capital of the firm, after returning fifty-sevenfold," and the manufacture he originated is now estimated to be worth, no less than £20,000,000 yearly.

BY a happy accident, just as a plan for a topographical survey of Massachusetts is being considered, the discovery has been made of some original unpublished documents, relating to the former geodetic survey, by Borden. One is a letter of forty pages, addressed to the Hon. Theophilus Parsons, then chairman of the joint committee of the legislature, in which Mr. Borden reviews the whole matter of the State survey describing in a very simple manner the methods used and the results obtained, and concluding with a detailed statement of the expense of the work from 1830 to 1841: the other is a paper addressed to the American Academy of Arts and Sciences, dated August, 1850, in which is described in great detail, accompanied by carefully-drawn plates, the base measuring apparatus, devised, constructed, and used by Borden in measuring the base-line in the Connecticut valley. The work done with this apparatus was of the most accurate character, the difference between two measurements of a line over seven miles long being less than a quarter of an inch. This paper was sent to the Academy; but, after various wanderings, both have reached the hands of Professor Vose of the Massachusetts Institute of Technology, who has presented them to the Academy. It is to be hoped that the Academy will print them in full at an early day.—*Science.*

NEW YORK'S inhabitants are crowded upon every available foot of ground, and the population massed and packed without regard for health, cleanliness or common decency. Sanitarians say that the maximum density of population compatible with health is 100 persons per acre. New York, as a whole, exceeded this four years ago. In 1880 seventeen out of twenty-two wards exceeded that estimate. One ward, the Tenth, had the enormous number of 432 per acre; four wards had from 300 to 350 per acre; five other wards ranged from 200 to 250 per acre. The Tenth Ward's population is at the rate of 276,480 persons per square mile. Enormous as this may seem, there are sections still more crowded. The election districts in New York comprise a single block or square, having upwards of 2100 inhabitants. There are thirty-one of these districts, in which the rate of population ranges from 580 to 1806 inhabitants per acre, or at the rate of 371,481 to 1,022,687 to the square mile—the average being 841 to the acre and 539,713 to the square mile. The total actual population in these thirty-one blocks in 1880 was 75,204 persons. Only twenty-three cities in the country had at that time a larger population than was confined in these thirty-one blocks, which covered an area of only ninety-two and one-half acres.

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WE are indebted to the courtesy of Thos. J. Long, Mem. Am. Soc. C. E., Asst. Engineer Department of Docks, New York, for the article on Pile Driving in Japan, the text and sketches for which were sent him by Prof. J. A. Waddell, of the University of Tokio, Japan. The American and English methods of Pile Driving are now introduced into Japan.

THE Annual Convention of the American Society is now in order for engineers to think of. The place of meeting, Buffalo, is very "handy" for most of the members, and on account of exceptional transportation courtesies, the expense this year will be comparatively light.

THE names of intending visitors to the Convention are already coming in to the Secretary, who, with several assistants, is deep in the usual preparations for this pleasant annual reunion of members. There is a great deal of labor incident to preparing for and organizing such a convention, and Secretary Bogart is entitled to great credit for the uniformly successful carrying out of his part of the programme.

THE local committee in Buffalo are endeavoring to make the visit to their city an enjoyable event. The annual "Souvenir," a feature started in Boston in 1878, and now become one of the most interesting momentos of the convention, is being prepared at an expense of $1,000 by leading engravers of Buffalo; the Genesee House has been engaged for headquarters, but other hotels will have to be called on for additional accommodation.

WE take from a Buffalo exchange the following:

"Most of the members will probably arrive on Monday, June 9. On Tuesday morning a business meeting will be held, and in the afternoon, by invitation of the officials of the Erie and Buffalo Creek Railroad Companies the visitors will visit the Tifft Farm by special train, examine the great improvements made and being made there by the Lehigh Valley Railroad and Coal Companies, and subsequently visit the extensive works of the Union Bridge Company near the foot of Hamburgh Street. On Wednesday morning another business meeting will be held, and in the afternoon the visitors will be taken on a trip down the river to Falconwood, where a delightful time is assured, the return to be made by moonlight. On Thursday, after the usual business meeting, the whole party will visit Niagara Falls by special train over the New York Central Railroad and enjoy the suberb scenery about the grand cataract. A luncheon will be served at the Falls and after the return a promenade concert, with refreshments, will be served at the Buffalo Club. The final business meeting will be held on Friday morning and on the evening of that day the members of the Society will be given a grand banquet at The Genesee, at which none but members will be admitted, even the ladies being excluded. The programme is certainly a fascinating one; the time of year is most delightful and the result is sure to be all that the most exacting can wish."

OUR London cotemporary, *Engineering*, in a late and rather discouraging editorial comment upon the present status of the Panama Canal, falls into an error in geography, in speaking of the American dredgers.

The statement is made that the Canal Co. obtained "a monster dredger from San Francisco," and put it to work at Colon; as these two cities are upon opposite sides of the Continent, the dredge must have doubled Cape Horn before reaching Colon, a feat of ocean navigation not contemplated by its builders.

These dredges were, in fact, built in Philadelphia, Pa., and were towed from there to the Isthmus.

THE TRAVELLERS INSURANCE CO., of Hartford Conn., have issued a chromo-lithograph of the proposed Statue of "Liberty Enlightening the World", as it will appear when erected upon Bedloe's Island. This picture, which is a work of art in itself and the finest we have yet seen of the proposed Statue, is published by the enterprising firm of Root & Tinker, of the Tribune Building, New York City, and is a credit to their good taste and business energy. The lithograph is endorsed by the Statue committee.

The B. & O. Bridge Across the Susquehanna River at Havre de Grace, Md.

Upon a recent visit to this locality, we found the work well in progress, and give the results of our hasty inspection.

This bridge, by which the Balt. & Ohio R. R. will cross the Susquehanna River on their new line from Baltimore to Philadelphia, is located about half a mile above the P. W. & B. Bridge, and passes over the upper end of Watson's Island. The total length of the structure will be somewhat over 6,000 lin. ft., 2,000 lin. ft. being iron trestle-work, about 70 ft. high, over the island. The bridge proper is made up of two iron spans of 520 ft. each, four of 480 ft. each, two of 380 ft. each and one of 200 ft.; One 520 ft. span over the west channel, and one 380 ft. span over the east channel, are through spans, the remainder are deck spans. The elevation of the rail will be about 93 ft. above ordinary water in the river.

The piers will be of granite, handsome in design and substantial in proportions. The foundations are worthy of especial note, combining as they do some very difficult engineering problems. Five of them will be put down by the plenum-pneumatic process, on timber caissons. This portion of the work is being done by W. Sooy Smith & Son, of Chicago, though in this case Mr. Chas. Sooysmith is directly in charge, has organized the work, and made many improvements in the general plant, which prove him an apt pupil of, and a worthy successor to, his father, whose name has been so long identified with the use of compressed air in the United States.

Commencing at the west end of the bridge, the relative depths of water and mud at each caisson foundation are as follows:—Pier 2, 11 ft. of water 56½ ft. mud; Pier 3, 12 ft. water, 59 ft. mud; Pier 4, 29 ft. water, 32 ft. mud; Pier 8, (east channel) 29 ft. water, 55 ft. mud; and Pier 9, 41 ft. water, and 33 ft. mud.

The caissons are built of 12×12 in. hard pine, the largest one is 78½ × 42½ ft., outside dimensions, the smallest 63½ × 26 ft.; the sides of the caisson are 3 ft. thick, the inside and outside courses being vertical, the centre course horizontal; the working chamber is 9 ft. high, with a roof of squared timber 8 ft. thick; above the roof the caisson is divided into cells by solid courses of timber, and these cells filled with concrete, made from English Portland cement 1 to 2 of sand. The cut stone of the piers will extend upward from the present level of the river bottom, according to the present plan. The caissons for piers 4 and 8 are being sunk, and two of the others are framed at the yard, below the present railroad bridge, and are ready to be towed into position.

The general plant and its arrangement for economizing time and labor is very complete. A large scow holds the compressors, boilers, concrete-mixers, etc. Among the compressors we saw two Ingersoll machines, one a Straight-line single compressor, and the other a Duplex; alongside of one of the Ingersoll's stands a straight-line Duplex compressor, designed by Gen. Smith, and used by him for the last fifteen years, it is in excellent working condition and is very much like the Ingersoll Duplex in general form and indentical in the design of its valves, it is planned to carry a hoisting drum between the engines. All machinery, for each caisson, is of course in duplicate.

The widest departure from old-time methods is in the appliances for mixing the concrete; this machinery is the invention of Mr. Chas. Sooysmith, and this is its first practical application. The prime object in view is the automatic measuring of any desired proportions of cement, sand and broken stone, and the automatic mixing of the same into a first-class concrete. We expect shortly to give a more complete and illustrated description of this ingenious machine, and for the present will only say that the materials are accurately measured and thoroughly mixed automatically, without depending, as in the past, upon the shovels of workmen; and the entire machine is run by one engine, with a speed regulated for each part to be performed. The manual labor is reduced to a minimum.

The caissons are fitted with the usual air-lock, supply-shafts, and sand-blowing pipes, though in each case some new features are present, which will require further illustration. The tightness of the working chamber is proven by the fact that no compressing is done on Sundays, and the chamber is found on Monday morning with very little water in it, showing that there is no appreciable leak.

Among the difficulties referred to, beyond the great depth of water and material, are the presence of great quantities of carburetted hydrogen gas in the mud bottom, liable to explosion, and the very irregular character of the rock under Pier 9, where the slope is 18 ft. in the width of the caisson. To avoid, as much as possible, the danger from a gas explosion, electric lights with double glass globes, are being fitted up in the working chambers. The best method of leveling the rock under Pier 9, has not yet been decided upon; blasting with dynamite through pipes has been tried already but the result has not been encouraging.

On the part of the Balt. & Ohio R. R. Co., Col. Wm. M. Patton is the engineer in charge of the bridge, and is to be accredited with the location and general plan of this interesting work. Col. Patton was the engineer of the Point Pleasant bridge over the Ohio River, and is an experienced, careful and conscientious engineer. When completed, this new bridge will undoubtedly be the finest and most imposing of the many structures now spanning the Susquehanna, and will well illustrate the advance made in the art since 1866, when its neighbor was built, with its pile foundations, and wooden arched-Howe trusses.

As previously mentioned, in our issue of April 12th, the contractors for the masonry are Jones, Drake & Co., of New York; and the Keystone Bridge Works is to build the iron superstructure.

Report of the City Engineer of Boston.

The Seventeenth Annual Report of the City Engineer of Boston, Mass. for the year 1883, commences with a classification of the duties of the office; these include the building and maintenance of city bridges, wharves, streets, etc.; the superintendence of the Sudbury River, Cochituate and Mystic Water-works, including all new construction; the construction of the new system of intercepting and outlet sewers; and the engineering work of the Back Bay improvements and proposed parks.

The engineering expenses for the year 1883 were $29,844.50. The total number of bridges within the limits of Boston is 91, of these Boston wholly supports 37, and partially supports 19 more; the remainder are cared for by the different Railroad Companies centering in the city.

The report upon the Sudbury, Farm Pond, Mystic Lake, and Lake Cochituate water supply, will be found under the head of "Water" in this issue of ENGINEERING NEWS.

Under the head of Improved Sewerage, it is stated that while yet incomplete in all its details, the main drainage works were sufficiently advanced on the first of last January, to permit the works being put into operation, so as to relieve the most serious nuisances which the system was designed to remedy. At present all the sewage which formerly emptied into Stony Brook, Back Bay, Charles River, as far north as Cambridge Street and Fort Point Channel, is discharged into the outer harbor, near Moon Island, at a point about five miles from the city proper.

Extensions of the intercepting sewers are now in progress of construction, by which nearly all of the remaining city sewage can be removed to the same point.

The serious evils in the old system which these main drainage works are intended to remedy, are the damming up by the tides, of the city sewers, and the discharge of sewage on the borders of the City. The system is not designed to prevent wet cellars due to heavy rains; no sewers or pumps which it would be practicable to build would be of sufficient capacity for this purpose. Nor will the new works by themselves constitute an entirely efficient system of sewerage for the city; nor completely remedy the defects existing in the old system. The defective size, shape and condition of the old sewers, leading to the new outlets, must all first be improved.

A very clear and brief outline of the main drainage works, is given in this report. Still more briefly sketched, it amounts to this: A number of intercepting sewers encircle the city, into which the old city sewers empty; the former outlets of these last are sealed by tide-gates, which exclude tide-water, but permit the escape of excess of storm-water. The several intercepting sewers unite in a large main sewer, which conveys the sewage to the pumping station at Old Harbor Point, in Dorchester. The gradients in the intercepting sewers are necessarily flat, with a resulting velocity of from 2 to 4 feet per second; flushing gates at one half mile intervals permit scouring when necessary.

At the pumping station, the main sewer, 10½ ft. in diameter, delivers its flow 14 ft. below low water; the sewage passes through screens before reaching the pumps, which latter raise it 35 ft., or high enough to flow by gravitation to the outlet on Moon Island. Four pumps, of a capacity of 25,000,000 gallons each, in 24 hours, are now provided, though there is little doubt that, without running at undue speed they can deliver 35,000,000 gallons each per day. Two of these pumps were from the design of E. D. Leavitt, Jr., and two from H. R. Worthington. Steam is furnished by four steel boilers of 250 H. P. each, one of these is sufficient for ordinary use, doing all the work of pumping, manipulating gates, lifting filth cages, etc., The coal house stores 3000 tons of coal.

After being raised by the pumps, the sewage passes from the force mains to two tank sewers, each 8 ft. wide by 16 ft. high and 1200 ft. long, extending out to the west shaft of the tunnel under Dorchester Bay. A depth of 8 or more ft. is maintained in these sewers, and the velocity being low, any road detritus or other heavy matter is deposited and retained by low dams, before it can get to the tunnel. Reaching the west shaft the sewage descends 150 ft. to the level of the tunnel, flows on a nearly level grade 6,100 ft. to the east shaft, and then rises 1 ft. in 6 ft. for a distance of 900 ft. to the end of the tunnel, on Squantum Neck. The tunnel is circular, 7½ ft. clear diameter, and the normal velocity of the sewage in it is a little less than one foot per second, but in time of rain the pumps can maintain a velocity of over 3½ ft. per second, sufficient to scour out any sludge that may have settled in the tunnel; flushing gates are also provided at the east end of the tank sewers to further increase this scour, when required; and a large mining pump is to be located in the east shaft, so that the tunnel can be emptied and examined and cleaned if found necessary; the sewage meanwhile escaping, by provided outlet at the west shaft into Dorchester Bay direct.

Across the flats lying between Squantum Neck and Moon Island, the sewer is carried on an embankment, and empties into a masonry reservoir on Moon Island; this reservoir stores 25,000,000 gallons, or more than twice the ordinary sewage flow between high tides. It is divided into four parts, which can be used independently, and so cleaned.

The sewage is discharged shortly after high water, when there is a good current setting seaward. Observations made since the discharge has commenced, show that while it discolors the water at its point of discharge, this discoloration is entirely lost within one mile of the reservoir, and its presence cannot be detected at all.

The total amount expended to Feb. 1, 1884, for constructing an improved system of sewerage, is $4,664,416.25; there remains of unexpended appropriation needed for further work, $588,583.73.

The report concludes with a statement of work upon the Back Bay improvement.

PERSONAL.

AMONG the latest weddings in St. Louis is that of Mrs. M. Devereux, sister of Bishop Ryan, to Colonel E. S. BOWEN, of New York, Vice-president of the New York, Lake Erie and Western Railway. The ceremony was performed by the Bishop.

JOSEPH WALTZ has been reappointed for his sixth term as City Civil Engineer of Dayton, Ohio, by the unanimous vote of the City Council. This may be considered a very good endorsement for a public officer.

THE salaries of the City Engineers' Department at Cleveland, O., are as follows: Civil Engineer, $3,000; First Assistant Engineer, $2,400, an increase of $400; Second Assistant Engineer, $1,800, an increase of $300; Third Assistant Engineer, $1,500, an increase of $300; Fourth Assistant Engineer, $1,200; Draughtsmen, $1500, an increase of $300; Clerk, $600, a decrease of $120; Rodmen, each, $720 an increase of $120; Chainmen, each, $600, an increase of $120.

DUTTON WOODS of Concord, N. H., widely known as a very successful and skillful bridge builder, died on the 2nd. He was born in Kenniker, Oct. 19, 1809, and removed to Concord in 1852. He began bridge building in 1837, and for a number of years was employed on the Hartford and New Haven, Connecticut, White River, Northern, Concord and Contoocook Valley Railroad. He was Bridge Agent of the Concord Railroad from 1855 until his death. Among his best works was the construction of the large double tracked bridge at Goff's Falls, on the Concord Railroad, where, from the beginning to the completion, not a single train was interrupted.

GEO. MORTON has been appointed City Civil Engineer of Sandusky, O., to fill temporarily, the office.

FRANK PAGE at Scranton, Penn., May 6, a veteran railroad conductor, died suddenly of heart disease. MR. PAGE was one of the best known and most popular men in this part of the State. He was born in Boston in 1829, and was actively identified with the early railroad development of this valley, having had charge of the construction of the Southern Division of the Delaware, Lackawanna and Western Road. He was also associated with Sidney Dillon in operating the Boonton Division of the Delaware, Lackawanna, and Western Road, between Boonton and New York, and was one of the original contractors for the elevated road. He took an active part in the construction of the New York, Lackawanna, and Western Road, from Binghamton to Buffalo, and afterward filled an important contract on the West Shore. His funeral took place last Thursday. He was buried at Cedar Ridge Cemetery, near Paterson, N. J.

Engineers' Club of Philadelphia.

(Record of Regular Meeting, May 3, 1884.)

Vice-President J. J. deKinder in the chair; 32 Members and 6 Visitors present.

Mr. S. N. Stewart, Visitor, exhibited a model of his River or Current Motor. Paddles are placed upon cranks and maintained in a vertical position by long floating vanes or tails. The cranks are placed upon posts, rafts or boats in the stream and journaled at the water-line, thus keeping one-half of the paddle surface in action, while the common floating-wheel or current-wheel only keeps one-tenth of its surface in action. In Mr. Stewart's motor a 10 ft. arm carries a paddle 10 ft. high. For particulars concerning this engine, he refers to "Commercial Relations of the U. S.," 1881, p. 682 or *N. Y. Daily Tribune*, June 21, 1881. Mr. Stewart said "the only way to utilize the power of large rivers is by current-motors, for dams are not permitted and are too expensive; that a current of five miles an hour has one hundred times the pressure of wind at ten miles an hour, and that, as the current soon regains its normal velocity, it can be used over and over."

Mr. Thomas M. Cleemann read a paper on an Economical Form of Bridge Truss. In outline it resembles Whipple's arch truss, inverted so as to bring the curved portion in tension, but differing from it in having the chord made to resist tension and being anchored to the abutments. In this way the only parts of the bridge in compression are the vertical posts, and the extra material, required to stiffen the upper chord in an ordinary bridge, is saved. To illustrate the correctness of his conclusions, Mr. Cleemann had a small model made of pink wrapping twine that broke with five and a half pounds, and with posts made of wooden knitting needles. This model, by calculation, ought to have borne about eleven pounds. After loading it with a pound weight at each of the seven panel points and letting it remain for a little time for the inspection of the members, he added first two more pounds at the centre, and afterwards two pounds more. With this eleven pounds the model hesitated a moment and then broke at each abutment, nicely illustrating the author's conclusions. He likewise gave the saving of material in such a bridge over a Pratt truss of five hundred and sixteen feet span, and pointed out its advantages for military purposes, where facility of transportation is a prime object, and a bridge almost entirely of rope is especially valuable on this account.

Mr. C. Henry Roney exhibited a section of four-inch Wooden Water Pipe and Joint, found about two feet below the surface while excavating a trench for the conduit of the Philadelphia Sectional Electric Underground Co., on Chestnut Street between Fourth and Fifth, and described those which had been found on Chestnut and Market Streets during the progress of the work. These are interesting as showing the durability of such pipes and connections, under the conditions to which they had been subjected.

Mr. W. G. Neilson read some notes on the recently published Report of the Gun Foundry Board. The recommendations embodied in this report, in regard to the establishment of a gun factory at Watervliet Arsenal, West Troy, New York, for the manufacture of guns for the Army, and at the Washington Navy yard for the Navy, and that the Government should depen1 upon the steel manufacturers of the country for its forged steel and should simply finish the guns in its factories, were referred to, as also were the interesting facts collated by the Board, during their visit to Europe, in regard to the character of steel used for guns.

The secretary exhibited, for Mr. J. H. Harden, a neat Topographical Model of the Jones Iron Ore Mine in Berks Co., Pa., and briefly explained the method by which such models are constructed.

American Society of Civil Engineers.

At the meeting on Wednesday evening, Vice-President Paine in the chair, and a "full house" of members present, the following were elected: *Honorary Member*, Gen. John Newton, Chief of Engineers, U. S. A., Washington, D. C.

MEMBERS.—Willis D. Chapman, Civil Engineer, Akron, Ohio; John Eugene Cheney, Ass't Engineer, City Engineer's office, Boston, Mass.; Arthur DeWint Foote, Civil Engineer, New York City; George Samuel Gatchell, Gen. Sup't Buffalo, New York and Philadelphia R. R., Buffalo, N. Y.; Henry Louis Marindin, Assistant U. S. Coast and Geodetic Survey, Boston, Mass.; Evelyn Piereponte Roberts, Civil Engineer, Fort Hamilton, New York Harbor, N. Y.; Jesse Wager Walker, Sup't Shiffler Bridge Works, Pittsburg, Pa.

JUNIORS.—Henry Goldmark, Civil Engineer, New York City; Samuel C. Weiskopf, Ass't Engineer, Chicago, Milwaukee and St. Paul Ry., Milwaukee, Wis.; Herbert Andrew Young, Ass't Engineer, Toledo, Cincinnati and St. Louis R. R., Toledo, O,

The paper by James Christie, M. Am. Soc. C. E., on "Experiments on the Strength of Wrought-Iron Struts," was discussed by Messrs. Bates, Boller, Bouscaren, Fuertes, Pegram and Cooper, and the author.

A paper on the "Strength and Elasticity of Structural Steel, and its Efficiency in the form of Beams and Struts," by James Christie, M. Am. Soc. C. E., was read and afterwards discussed by Messrs. Cooper, Towne, Schneider, Emery, Dorsey, Roberts, North, and the author. The paper excited a great deal of lively interest, and will be further discussed at the Buffalo Convention.

The Largest Gun in the Country.

BOSTON, Mass., May 7.—There was successfully cast yesterday at the South Boston Iron Works, in fulfillment of a contract with the United States Government, the largest gun ever constructed in this country. When fully completed it will be about thirty feet in length, of twelve-inch rifle bore, and will weigh 212,000 pounds. The cost of the gun will be $28,000, or about one-half the sum a steel gun would have cost. It is calculated to be able to throw a projectile a distance of six miles.

CORRESPONDENCE.

In Union Is Strength.

BOSTON, May 5, 1884.

EDITOR ENGINEERING NEWS:

I wish you would make known that the Boston Society of Civil Engineers at its recent annual meeting passed by a vote of 32 to 0, a resolution expressing its satisfaction with the joint publication of papers by the Association of Engineering Societies, and inviting all local engineering societies in North America, to join the Association. Respectfully,

FRED. BROOKS.

Obstruction of Cross Gutters to Surface Drainage.

NORWICH, CONN. May 6, 1884.

Special Correspondence Engineering News.

EDITOR ENGINEERING NEWS.—I was pleased to see Mr. Conover's letter regarding culverts and street intersections.

They have been considered unsatisfactory here for the following reasons.

1. They obstruct the gutter for use as a portion of the street in driving.

2. They easily become obstructed by leaves, sticks and in an unpaved street with sand, etc.

3. They easily become obstructed by slush and ice in the winter, especially on those days when it thaws during the middle of the day and freezes at night.

Will Mr. Conover please give a detailed plan of a culvert and street crossing complete, for as large an amount of water as he thinks is advisable to carry in an open gutter, for street with one per cent grade,

Yours truly,
CHAS. E. CHANDLER.

Construction of Race Courses.

FT. COLLINS, COL., April 26, 1884.

EDITOR ENGINEERING NEWS.

To set off the one mile and half mile lines for race tracks, easing off the approaches to the curves, the following formulas are offered, deduced by the aid of "Searles' Railroad Spiral."

For one-mile track, true line three feet from inside fence, lay off two parallel tangents 946 feet long and 855.51 feet apart. Set up the instrument at the end of one of these tangents and set out a spiral of 17 chords, each 22 feet long, deflecting towards the other tangent, to the various points on the spiral as follows—the transit point being O:

1	0° 05′ 00	10	3° 12′ 28″
2	0° 12′ 30″	11	3° 49 56″
3	0° 23′ 20″	12	4° 30′ 44″
4	0° 37′ 40″	13	5° 14′ 50″
5	0° 55′ 00	14	6° 02′ 15
6	1° 15′ 50″	15	6° 52′ 57″
7	1° 40′ 00	16	7° 46′ 57″
8	2° 07′ 29″	17	8° 44′ 12
9	2° 38′ 19″		

Remove the instrument to the extremity of the 17th chord = Sta. 3 + 74, and with backsight on O deflect 16° 45′ 48″ for tangent line to T. P. From this point set off, by short chords, 946 feet of curve with radius of 421.17 feet = 13° 38′ 11″ curve to station 13 + 20, which is the point where a similar spiral from the other tangent will join the curve. Set up at the extremity of this tangent and work back. The deflection of the spirals is 25° 30′ each, and of the main curve 159°.

For one half-mile track, true line 3 feet from inside fence, lay off parallel tangent 400 feet long and 450.32 feet apart. Proceed as before with 20 spiral chords of 13 feet each—the deflections being the same to 17, to 18, 9° 44′ 43″ to 19, 10° 48′ 27, and to 20, 11° 55′ 24″. Remove the instrument to extremity of 20th chord = Sta. 2 + 60, and with backsight on O deflect 23° 04′ 36″ for tangent line to T. P. Set off by short chords 400 feet of curve having 210.36 feet radius = 27½° curve to sta. 6 + 60, which is the point where a similar spiral from the other tangent will join the curve. Proceed as before. The deflection of the spirals is 35° each and of main curve 110°.

D. W. C.

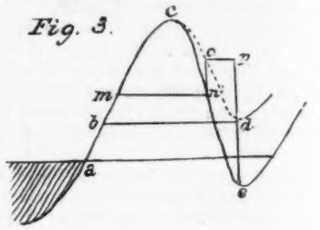
Graphic Method of Balancing Profile Quantities.

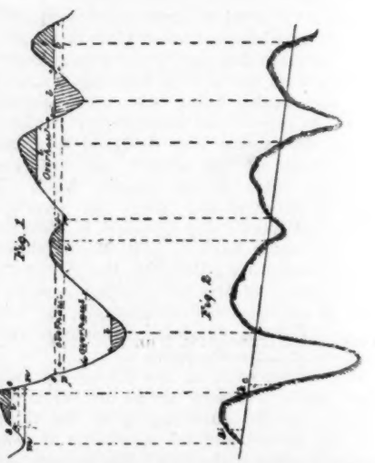
Special Correspondence Engineering News.

DIVIDING RIDGE, SOMERSET CO., Pa., April 4, 1884.

EDITOR ENGINEERING NEWS.—Some of your readers may already be acquainted with the graphic method of balancing profile quantities on a railway location. For those who have never seen this, it may be of interest and benefit to become acquainted with this easy, and, if I may say so, interesting and agreeable way of deciding the location of the most economical places of overhaul and borrow, instead of the old tedious, laborious and very approximate manner of doing this. Supposing on the estimate sheets, when the quantities have been calculated for each station, one more column being added, called the "summation column" and the figures in this, opposite each station, representing in cubic yards, subject to the usual increase or decrease for different kind of material, the arithmetical sum total of all the station quantities up to that station, taking cuts as plus and embankments as minus; then we can from this column construct a profile taking one yard or 1000 yards, whichever most convenient, as units for height. This profile, called the distribution profile, can of course either be plotted above the ordinary surface profile or on separate paper. Common cross-section paper, where the squares are called 100 feet long, 1000 yards high, will in very rough country, perhaps, be found most convenient.

If we have the two profiles plotted on same paper, the distribution at the top, it will be seen that all the culminating points in this will be opposite or directly above the grade points in the common profile.





Let Fig. 1, and Fig. 2, represent these two profiles, which are rather exaggerated in order to take as little space as possible. Having decided on the limit of haul, calling this length "*l*", we can easily determine where and how much of the excavation will balance within this limit, by doing as shown on the sectional space in Fig. 1. The excavation between the station *a b* will be equal to the amount of fill between *b c*; because the nature of this distribution is such, that the sum of the quantities between any two points is equal to the vertical distance between same expressed in cubic yards. Therefore as the vertical distance in Fig. 1. between *a b* in the cut is equal to this same between *b c* in the fill, it follows that the volume of material between *a b* is equal to the volume of fill between *b c*; *m a* is the remainder of the cut, and will, as the figure shows, be equal to the fill between *c n*, but it has to be overhauled. The length of overhaul is the difference between the distance and centres of gravity of the volume in the cut and the same moved to the fill and the limit of haul. The centre of gravity must be at the points where the volumes, each side, are equal or half way vertically between *m* and *a*, or *c n*. The distance between these centres of gravity can then be measured accurately from the profile Fig. 1, and minus *l* the limit of haul, gives us the exact length of overhaul, the quantities for which is the vertical distance in cubic yards between *m* and *a*. Thus in the same way can be determined the overhaul for the fill between *p* and *g*. It depends upon the cost of excavating for borrow, whether the price of overhaul will permit the same as indicated, at *o p* it could otherwise be hauled the other way. The embankment between *s o* will have to be borrowed. After very little study, one becomes easily familiar with the use of the distribution profile, and can at a glance determine the best location for an overhaul or borrow

It might be said that the calculating of the summation column takes much time and labor, but as it consists only in adding the station quantity, increased or decreased at a certain rate, for different kinds of material to the preceding summation quantity, it is very simple and can therefore be done by any men in the lower ranks of the locating party. It gives besides a thorough check on all other necessary summation. The merit of this method is evident in the fact that any one who has studied it, never will use any other but this one. Following example, may also illustrate the advantage of the distribution profile.

On a certain railroad location it was desired to make

both single and double track estimates. To test the economy of first cost, an estimate was also required, where on certain points all cuts were to be double track and adjoining fills as far as material would allow, the rest single track, or no borrow whenever possible. Then has to be determined how far a double track cut will double track the adjoining single track fill. Referring to Fig. 3, let $a\ c$ be the double track cut and $c\ d$ the single track fill, and $c\ e$ the same fill but double track. It will be seen the cut between $b\ c$ will equal the single track fill $c\ d$, and leave a remainder $a\ b$. If we find a point between the two lines representing the single and double track fills, where $o\ n = a\ b$, then this fill can be double tracked to this point or station, indicated by the vertical line $o\ n$. If $o\ n = a\ b$ then $p\ d = a\ m$.

Yours truly,
G. H. VEDELER.

LITERATURE.

Foundations and Foundation Walls, for all Classes of Buildings, Pile Driving, Building Stones and Bricks, Pier and Wall Construction, Mortars, Limes, Cements, Concretes, Stuccos, etc. Practical explanations of the various methods of building foundations for all kinds of buildings, etc., etc. By GEO. T. POWELL, Architect and Civil Engineer, New York. To which is added *A Treatise on Foundations, with practical illustrations of the method of isolated piers, as followed in Chicago.* By FREDERICK BAUMANN, Architect. Revised and enlarged edition. Published by Wm. T. Comstock, New York. Price $2.00.

The above work relating to foundations and "practical explanations" of the methods of building them, is evidently the work of a novice in engineering, notwithstanding the assumption of the title tacked on to his name. His description of methods is crude, incomplete, and, in many cases, incorrect, and the man who buys the book with the idea that he will learn something new, or even have good old methods explained to him, will be sorely disappointed. The illustrations confuse, rather than explain the text. For example, in treating of "rock with clay," he makes the sage remark that such a foundation is unsafe "without artificial treatment;" without further explanation of the particular artificial treatment referred to, he gives a "practical illustration" in Fig. 3, which is a regular "what-is-it." He attempts to explain by telling us that the opposite side would be liable "to move from the pressure of the load on the arch (and it ought to move pretty fast according to the sketch); this may be made secure by drilling and driving iron bars into holes passing through the strata."

In testing the bottom of the foundation, the author recommends a "common wood auger," which he says will bring up samples of the soil; or these may be removed by a "long-handled scoop." "The important object to be attained in using an auger is to learn the character of the underlying strata"—this is a fact worth remembering.

His description of pile foundations is pure nonsense, and is worthy of no further comment. In fact, the only good portions of the work are represented by the "padding," in the shape of copious abstracts from other authors, nor are these even always selected with judgment.

We regret that a firm of the standing of the publishers of the present book should have been led into inflicting it upon the general public. And as this is a new and revised edition, we cannot help wondering where the victims came from who exhausted the first.

Picturesque B. & O. Railroad.

If Pangborn, when a newspaper man, displayed half the ingenuity and originality he has since his advent with the B. & O., he certainly must have kept things lively. He is out with another B. & O. book as wholly different in conception and general style from last year's publication as it is possible to imagine. The latest is entitled "Mountain and Valley Resorts," and is a most exquisite thing. It is printed upon heavy paper; the views of the different resorts most exquisitely rendered (in no one can tell how many colors), and counterfeiting nature to perfection. The letter press is in maroon, and throughout the reading pages are ornamental panels in various shades and producing lovely contrasts. The book is a gem, and unquestionably reaches the highest standard of art yet accomplished by any railroad company. As usual, a request made by mail to C. K. Lord, G. P. A., Baltimore, with a two-cent stamp for postage, will secure a copy.

Annual Report for 1883 of the City of Dallas, Texas.

W. M. Johnson, City Engineer, reports as follows upon the work done:—Upon plans recommended by him, the City Councils adopted the separate system of sewerage for their city, and 11,500 ft. of pipe sewer and 5,700 ft. of brick sewers have been completed. One of the main streets in Dallas was laid last year, for 2,300 ft. in length, with Bois d'Arc blocks upon a gravel foundation. The total amount of work done in the engineering department in 1883, cost $125,738.05

A. M. Wheless, Superintendent of Water-works, reports, total expenditures $19,293.68; received from consumers $16,025.77; crediting the works with permanent improvements, $7,716.78, they are found to be not only self-supporting but a paying department of the city. The a tention of the City Councils is called to the fact that the water supply is very short and needs immediate attention to meet the increasing demand.

Cassell's Family Magazine for May.

Just what it is represented to be—a family magazine full of pleasant and instructive reading for adults and also the younger members of the household. Stories, descriptive articles, chit-chat about dress, and short paragraphs on scientific subjects; beautifully illustrated throughout. Price $1.50. Published monthly by Cassell & Co., 739 Broadway, New York.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 219*)

DCXXIX. NAPA, CAL.

Napa, California, in lat. 38° 18′ N., long. 122° 16′ W., on the Napa River at the head of tidal navigation, is built in a valley between high hills.

Settled about 1854, it was incorporated a city in 1874. Water-works were built by a private company in 1883, after plans of G. F. Allandt, and under the direction of O. H. Buckman, the supply being taken from ground water. A test well 18 feet deep and 6 feet in diameter, was sunk in a saturated bed of gravel, and furnished a supply of 2,400,000 gallons in 24 hours. In order to establish the pumps on firm and high ground, a pump well 47 feet in depth and 5 feet in diameter was sunk, and at 40 feet below the surface a tunnel 6 feet high and 4 feet wide, was excavated 126 feet horizontally through volcanic rock; at this distance the roof of the tunnel being under the saturated gravel stratum, was blown out, giving the water free access to the tunnel and pump well.

The water is then pumped by a compound Harper pump of 12 and 20 inch steam, and 12 inch water cylinder, and 20 inch stroke, made by W T. Garratt, to a reservoir formed by building a masonry dam 167 feet long, 33 feet high, 7 feet wide at the top, and 22½ feet at the base, across a ravine. The reservoir has a capacity of 2,500,000 gallons and is at an elevation of 100 feet above the main street of the city.

Distribution is by 5½ miles of cast-iron pipe of 12 to 3 inches in diameter, with 28 fire hydrants, 15 gates, 3 meters, and 120 taps. Service pipes are of plain iron. The city pays $48 yearly for each hydrant. The population in 1880 was 3,731; it is now said to be 4,500.

The capital stock of the company is $150,000. There is no bonded debt. The works have cost $100,000. E. S. Holden is President of the Company, and E. S. Churchill, Secretary.

DCXXX. KINGSTON, N. Y.

Kingston, Ulster Co., New York, in lat. 41° 55′ N., long. 74° W., is on the Hudson River at the mouth of Rondout Creek, and comprises the Post Offices of Kingston, Rondout, and Wilbur.

Settled in 1666 it was incorporated a city in 1872. Examinations for the best source of supply were made for the city in 1883, by W. R. Hutton, C. E., and recommended by him. Water-works were built in 1883 by a private company after the plans and under the direction of A. L. Betts, C. E., the supply being taken from Sawkill Creek. An earth dam 190 feet long and 35 feet high with a heart-wall of masonry, founded on solid rock, was built across the creek, 7 miles North West of the city, forming a reservoir covering 19¼ acres, having a storage capacity, of 60,000,000 gallons, and receiving the drainage of 25 square miles of water-shed. The surface of the reservoir is 350 feet above mean tide in the river, giving a head of 170 feet at Kingston, and of 340 feet on the strand at Rondout. The water is taken from near the surface of the reservoir, and after passing through a charcoal and gravel filter is conveyed to the city by a conduit 37,500 feet long and 18 inches in diameter. Distribution is by 23½ miles of cast-iron pipe of 16 to 4 in. diameter, with 230 fire hydrants, 119 gates, 20 meters and 600 taps. Service pipes are of galvanized, and tar-coated enamelled iron, with lead connection at the main.

The city pays $40 yearly for each hydrant. The population in 1880 was 18,344.

The capital stock of the Company is $300,000 and its bonded debt is $300,000 at 6 per cent.

James G. Lindsley is President, and C. D. Bruyn Secretary and Treasurer.

DCXXXI. GARDNER, MASS.

Gardner, Worcester Co., Massachusetts, in lat. 42° 35′ N., long. 72° W., is built on high ground in very rough country.

It was incorporated a town in 1785. Water-works were built in 1880 by a private company, after plans of S. L. Wiley, taking the supply from Crystal Lake which has an area of about one square mile. The water is pumped by a Deane steam pump of 3,000,000 gallons daily capacity, lifting 100 feet to a reservoir holding 3,000,000 gallons, and being from 100 to 250 feet above the town.

Distribution is by 7 miles of cast-iron pipe of 18 to 4 in. diameter with 60 fire hydrants, 30 gates, 15 meters and 275 taps. The town pays $60 per annum for each hydrant. The daily consumption in 1883 was about 200,000 gallons. The population in 1880 was 4,999 and is now said to be 6,000.

The cost of the works has been $150,000. The capital stock of the company is $100,000, and its bonded debt is $60,000 at 6 per cent. S. L. Wiley is President, and H. W. Conant, Superintendent.

DCXXXII. HAVRE DE GRACE, MD.

Havre de Grace, Maryland, in lat. 39° 32′ N., long. 76° 5′ W., is on the Susquehanna River near the head of Chesapeake Bay.

Settled prior to the Revolutionary war, it was incorporated a town in 1874.

Water-works were built in 1883 and 1884, by a private company after plans of W. W. Taylor, the supply being taken from the river. The water is pumped by a duplex Blake pump of 6 inch water cylinder and 12 inch stroke, lifting 250 feet to a reservoir, holding 4,000,000 gallons covering 1½ acres, and being 210 feet above the town.

Distribution is by 4 miles of lap-welded wrought-iron pipe of 6 and 4 in. diameter with 35 fire hydrants, 14 gates and 50 taps. Service pipes are of wrought-iron. The town pays for

the use of hydrants, 5 cents per $100 of the assessed value of property, which now amounts to $500 yearly.

The population in 1880 was 2,816. The capital stock of the company is $15,000. The bonded debt is $15,000, 20 years at 6 per cent. A, P. McCombs is President, and W. W. Taylor, Superintendent.

WATER.

PORTLAND, DAK., is talking of an artesian well.

MR. WILLIAM R. DEVOE of St. Louis has accepted the position of Superintendent of the Wyandotte, Kansas, Water-works.

THE reward of $3,000 offered by Arizona for the first flowing artesian well in the territory has been awarded to C. L Whitney, of Pinal county.

AN iron foundry to cost $30,000 is to be built at Beverly, N. J., for a son of Jesse W. Starr, of Camden, who formerly owned and operated Starr's Iron Works.

THE Lloyd Valve Company, of South Bethlehem, have bought the plant of D. E. Pierce & Co., in addition to their speciality of the self-packing valve, and will now manufacture fine machinery castings and gas and gun metal castings of every description.

BYAR & BROTHER, founders and machinists, have purchased the foundry plant of Ellis & Lessig, Pottstown, and as soon as the weather will permit will build an addition to their foundry of thirty feet on York Street and extending a depth of ninety feet.

THE Committee on Water-works of the town of Berryville, Clarke County, Va., last week opened the bids received and acting under the advice of a consulting engineer connected with works belonging to a city in a neighboring state, rejected all the bids as being too high.

AT a recent meeting of the St. Paul, Minn., Water Board, Sanders and Matthews were awarded the contract to deliver 1,000 barrels of cement at $1.10 per barrel if delivered at Vaudnais Lake, and at $1.30 if delivered in St. Paul. W. F. Bailey's proposition to furnish the necessary brass goods for 1884 was accepted, and some additional men were put on the water force. The Engineer was authorized to advertise for bids for the construction of a terminal chamber at the end of the conduit, two waste weirs; a foundation for an engine house and smokestack, and pumping station, and various buildings at Vauduais Lake; also for lumber and the moving of buildings.

ANNUAL REPORT OF THE WATER COMMISSIONERS OF POUGHKEEPSIE, N. Y.—This is the fifteenth annual eport, and covers the year 1883. The commissioners report a very considerable outlay for extension of water mains during the year, works in excellent order, and quality of water good. The cost of maintaining the water-works and sewers was $17,636.46 as against $29,-388.40 in 1874, showing great reduction in working expenses.

The Superintendent reports that though the filter-beds have been severely taxed, all water consumed has passed through them. The sand bed is 24 in. thick, and this is cleaned by removing about ½ in. in depth of the sand layer twice in the year.

The amount of water pumped, in 1883; was 508,696,380 gals., with 1501 water-takers. The estimated cost of pumping 1,000,000 gals. 1 ft. high is $0,0651, and for filtration, for same amount, $0,118, making the total cost, as above, $0, 0769, for filtered water. The average cost per million gals. for cleaning filter-beds was $1.17, for washing sand, per million gals. $2.14.

ANNUAL Report of Water Board of Holyoke, Mass., for 1883. The receipts for the year were $62,098.05, of which sum $53,783.39 was for water rents. The expenditures amounted to $61,821.85, of which $15,000 was for interest on Water-bonds; $22,393.05 for 20,313 lin. ft. of supply mains laid; $5,485.33, on account, for the construction of a 70,000,000 gallon reservoir: $1,782.46 for supervision and inspection; and the remainder for sinking fund and general expenses, land damages, etc.

The total length of cast-iron mains is now 26 miles, 933 ft. and of temporary wrought iron mains, 4 miles 4,920 ft. The total number of services is 1,637, hydrants, 201, and of meters 118.

IN the Mass. Legislature last week the Committee on Water Supply reported:

By Mr. Kingsley of Cambridge, a bill providing that the town of Marblehead may supply itself with water at an expense of $200,000.

By Mr. Reed of Millford, a bill to incorporate the Framingham Water Company with a capital stock of $250,000.

By Mr. Foster of Medford, a bill to authorize the Revere Water Company to supply the town of Winthrop with water.

By Mr. Frisbee of North Andover, reference to the next General Court on the petition of S. K. Johnson and others, that the town of Andover may take water from the Shawsheen River for the purposes of a water supply; also on the petition of the city of Boston for authority to take the same water for the same purpose.

PLANS for a masonry dam to replace the one recently washed away at Ansonia, Conn., have been prepared by D. S. Brinsmade, C. E., of Birmingham Conn., and after being submitted to the revision of B. H. Hull, Hydraulic Engineer of Bridgeport Conn., have been accepted by the Water Power Co.

W. S. KUHN, Water-works Contractor, Pittsburg, Pa., has the contract for Sioux Falls, Dak. Five miles of pipe, 40 hydrants, $3000 per annum; pumped by water power. Mr. Kuhn owns the franchise and is his own contractor. Mr. Kuhn built the Uniontown Pa., Cornellsville, Pa., and Wellsville, N. Y. all gravity water works; has also the control of the Hornellsville, N. Y. works.

BOSTON WATER SUPPLY.—From the annual report of City Engineer Mr. Henry M. Wightman.

The daily average consumption of water from the combined works has been as follows:

	From Sudbury and Cochituate Works.	From Mystic Works.	Total.
January	34,715,500	8,369,600	43,085,100
February	32,690,700	7,714,650	40,405,350
March	34,110,700	7,737,300	41,848,000
April	30,617,600	6,171,150	36,788,750
May	32,169,500	6,319,100	38,488,600
June	33,419,200	6,912,550	40,331,750
July	36,774,000	7,307,550	44,081,550
August	37,141,000	7,261,500	44,402,500
September	33,645,000	5,846,300	39,491,300
October	29,575,860	5,497,250	35,073,050
November	28,839,300	5,930,600	34,769,900
December	30,174,200	6,771,500	36,945,700
Averages	32,836,900	7,093,500	39,930,400

The consumption from the Sudbury and Cochituate works shows an increase of 2.7 per cent., and that of the Mystic works 7.9 per cent. over that of the year 1882. The consumption of the first nine months shows a large increase when compared with the corresponding months of the previous year, while the remaining months exhibit a decrease. This reduction in the consumption is due to the saving effected by the stoppage of waste and to the effect of the cautionary notices issued on account of the low state of the supply.

The daily average consumption per head of population has been 91 gallons from the Sudbury and Cochituate works, 82.5 gallons from the Mystic works, and 89.5 gallons from the combined supplies. The total consumption of the Sudbury and Cochituate works has been 11,985,469,500 gallons, of which amount the Sudbury River works have furnished 8,455,000,000 gallons, or 70.5 per cent.

WASTE OF WATER.

Since the date of my last annual report, very great progress has been made in preventing the waste of water. The organization, by the present Water Board, of the Division of Inspection and Waste, and the systematic work which has been done already, prove that the prevention of waste to the extent of keeping the amount consumed within reasonable limits is entirely practicable. The details of the operations of this system of inspection and the appliances used in connection with it are so fully given in the reports of the Water Board to the City Council, dated Sept. 6 and Dec. 6, 1883, (City Documents Nos. 122 and 173) that it would be superfluous for me to repeat them in this report. It should, however, be stated that the results accomplished, as shown by those reports, are not of a temporary nature; the rate of consumption has steadily decreased, and it may fairly be assumed that the coming season's work, with a force now trained to its duties, and the application of a large number of the Deacon and recording meters, as guides to, and checks upon, the inspection and waste, will accomplish a reduction of the consumption to the rate, or below it, of sixty gallons per head of population per day.

GALVANIZED-IRON WATER-PIPES.—Dr. Von Ehmann, one of the principal technical authorities on the subject in Wurtemburg, has communicated to the *Deutsche Bauzeitung* various details as to the employment and preservation of galvanized wrought-iron pipes for the purpose of conveying water. For many years the use of these pipes has been general in Wurtemburg for conveying water from the cast-iron main pipes in the streets to the taps, etc., in private or public edifices. Before use the pipes are carefully tested for the suitable pressure of water, and also with a view to greater security for a still higher pressure (usually up to twelve or fifteen atmospheres). For branch pipes the use of any other metal is prohibited in most parts of Wurtemburg, so far as pipes of ½ inch to 1½ inch internal diameter are concerned. The regulations in force also define the thickness of the pipes, which should be fully one-sixth of an inch for one inch internal diameter. The galvanizing is on both sides, and the pipes are not allowed to be used until the official tests as to the pressure of the water have been held. The results of this system would seem to have been satisfactory as to the soundness of the pipes and their preservation. Thus it is recorded that after having been for several decades in use, pipes which were examined were found perfectly good and almost totally free from either internal or external incrustations. An exception, however, is made as to those situations in which the pipes have been exposed to influences of a character specially affecting their durability. This would seem to be specially the case in large stables, chemical factories etc., where solutions of nitric acid, ammonia, etc., would come into immediate contact with the pipes. In such cases it is thought advisable to use iron pipes (whether galvanized or not) as little as possible. The pipes of the description referred to by Dr. Ehmann are also said to have been objected to in various quarters, in the same manner as other kinds of pipes have been treated from time to time. The experience of their use is considered, however, to have refuted in a satisfactory manner any assertions of a prejudicial character. —*The Builder.*

ANNUAL REPORT OF THE WATER COMMISSIONERS OF TROY NEW YORK.

THE twenty-ninth annual report of the Water Commissioners of the City of Troy, N. Y. has been received, covering the year 1883.

The works have been enlarged and improved in the past year, by the construction of a new dam and distributing reservoir on the site of the old fire dam; at a cost of $26,500. This work was completed on Dec. 7th 1883, and the practical result is increased pressure to 60 lbs. in the older portion of the city, and to 72 lbs. on the lower and principal service.

In consequence of these improvements in 1883, the expenditures amounted to $178,842.52, while the income of the department was $131,231.33: the difference however was more than made up by the balance on hand at the beginning of the year.

The entire cost of the Water works to March 1, 1884, was $1,085,959.84, from their commencement in 1833.

The report contains a condensed Rain-fall statement, by months, from Jan. 1, 1826, to Dec. 31, 1883.

D. M. Greene, Chief Engineer of the works, reports that the total cost of operating and maintaining the pumping machinery, for the year 1883 was $19,013.97; of this amount 53.6 per cent. represents the cost of coal and wood, and 28.7 per cent. the labor account, supplies 5.7; engineering 4.3; repairs 4.7; gas, 1.8; telephone, 1.2

The cost of the pumping service was:—

Per *million* gallons raised 231 ft.	$13.69
" " " " 1 ft.	$0.05926
Per *thousand* " delivered into Oakwood Reservoirs.	$0.01369

The average duty of the engines per hundred pounds of coal burned while the pumps were in operation, for 1883, was 67,063,922 foot pounds.

The new reservoir built within the year has an elevation of 202 ft. above tide: two 24 in. distributing pipes lead the water to the city mains. The work on the dam was commenced in June 1883, and finished in Dec. of the same year; Contractors, Messrs. Sherman & McDonough.

A RESOLUTION was read before the Cincinnati O. Board of Public Works and recommended to Council for passage, providing for a supply of water for the adjacent village of Clifton. The document was drawn up by the Superintendent of Water-Works, and provides that a contract be entered into by the city of Cincinnati and village of Clifton, said village to furnish all details of pipes, valves and other materials, which shall at once become the property of the city, to be paid for at cost price by the city in water rents, to be collected by the village on bills at current city rates, made by the city, the entire amount of said bills which the village is to guarantee to be not less than $750 per six months, to be credited on account of said materials furnished until the same are fully paid for, when said city will collect from the water consumers within said village, who shall pay the bills for said water rents in accordance with city regulations; said village to furnish at its own expense twenty fire-plugs or more, and pay for use of each $20 per six months. Other customary conditions are included in the resolution.

THE Boston Water Board made an inspection of the several storage basins along the line of the Sudbury River on Saturday last, particularly the new reservoir at Ashland, known as Basin No. 4. The superintendent in charge of the work at this place expressed the opinion that it could not be finished in less than a year, but the Water Board are desirous of completing the basin by the first of January next, and to this end will increase the working force to 400 men, and will also employ 50 additional teams. The basin is designed to hold 1,000,000,000 gallons of water, and it is estimated that its total cost will be nearly $700,000. The other basins were found in excellent condition, and work on the Farm Pond conduit is progressing rapidly. Speaking of the supply which the Sudbury River system will give Boston, when finished, Chairman Simmons said that the capacity of the four basins would be as follows: Farm Pond, 130,000,000 gallons; Basin 1, 288,000,000 gallons; Basin 2, 480,000,000 gallons; Basin 3, 1,000,000,000 gallons; Basin 4, 1,200,000,000 gallons, or a total of 3,098,-000,000 gallons. Basins 1, 2, and 3 and Farm Pond were filled to their utmost capacity, and at present there was no danger from a lack of water, owing to the the careful system of inspection which had served to prevent a waste." "Mr. Simmons said: "A year ago we promised to reduce the consumption of water from 90 gallons to 60 gallons per capita, and we have done so without embarrassing or stinting anyone in its use, while at the same time we have done all in our power to give Boston as pure water as possible. The result of our labor thus far is that to-day Boston has as good and as pure water as any other city in the country. The daily consumption of water by Boston at present is about 23,000,-000 gallons a day, a reduction of 10,000,000, gallons per diem, compared with the corresponding period last year.

VALUABLE DATA REGARDING THE BALTIMORE, MD., GUNPOWDER SUPPLY.

The civil engineer of the water department has just had prepared for preservation and future reference a neat table of data in regard to the Gunpowder water supply, which is quite interesting. The Gunpowder permanent supply, embracing Loch Raven, Lakes Montebello and Clifton, upon which work is now in progress, cost about four and a half millions, but about $10,000,000 has been expended upon the city's supply, including the Jones' Falls' supply, etc. Loch Raven was begun on December 22d, 1875, and completed in November, 1880. It covers an area of water surface of 252 acres, is from 100 to 800 feet wide, and has a depth of water from 4 to 20 feet. The capacity of the lake is 510 millions of gallons. The elevation of the water surface at high-water mark is 170 feet above mean tide. Eight bridges span the lake, costing from seven to fifteen thousand dollars each. The total cost of the lake was $467,139.96. Loch Raven gate-house is built of white marble, the north wing being 205 feet in length, and the south wing 200 feet. There are seventeen gates; the cost of construction was $398 per gate.

The main tunnel was begun December 15, 1875, and completed November, 1880. The length of the tunnel from the portal in Loch Raven gate-house to the portal in Montebello gate-house is 36,443 feet, or nearly 6¾ miles. The length of the tunnel, in solid rock and not arched, is 24,752 feet. The maximum depth of shafting sunk in hard rock was 37.5 feet; minimum, 15.5 feet. The total number of cubic yards of drifting on main tunnel was 176,579, at an average cost of $6.62 per cubic yard.

The internal diameter of the tunnel is twelve feet, and the fall per mile one foot. The cost of graduation was $1,382,598.97; cost of arching, cleaning up of tunnel and filling shafting, $397,011.32; total cost $1,779,610.24. The capacity of discharge of the tunnel per twenty-four hours is 170,000,000 gallons. Length of the tunnel arched with brick, 11,971 feet.

Lake Montebello was begun on December 1, 1875; completed December, 1880. Number of acres, area of water surface, 59; capacity of lake, 496,378,144 gallons; depth of water, 30 feet; elevation of water surface at high-water mark, 163 feet above mean tide. It has a drain tunnel of 3,432 feet of which 2,873 feet is in solid rock.

NEWS OF THE WEEK.

Railroads and Canals.

A SURVEY is now being made for the Illinois Southern and Paducah Road. When completed, the road will give Memphis an outlet to St. Louis and Chicago. The enterprise is said to be backed by an English syndicate.

ENGLAND'S railways killed 1,230 persons last year and injured 8,123 others. More than half of these were injured from their own want of caution in passing over crossings and in other ways. Thirty-six passenger trains were in collision.

IT is said that the Santa Fe is about to build a line from Great Bend, Kan., to connect with the Burlington at Concordia. The road will be about 100 miles long, and will make the distance from Santa Fe to Chicago several hundred miles shorter.

ST. PETERSBURG, May 4.—Subscriptions more than seventeen times the desired sum are offered in response to a call of the Russian Government for a loan of £15,000,000 to be used in the construction of railroads. The *Journal de St Petersburg* says this brilliant result is an evidence of the immense recovery of Russian credit.

CERTIFICATES of incorporation have been filed as follows with the Secretary of State at Columbus, O.: The Middletown, Lebanon and Cincinnati Railroad Company, principal office Middletown; capital, $100,000. The Marksburg and Louisville Railroad Company, principal office Marksburg; capital, $150,000.

FAYETTESVILLE, Ark., May 2.—The Pacific & Great Eastern Railroad Company organized to-day by electing S. S. Davidson, of Arkansas, President; J. R. Metcalf, Secretary; J. S. Pollock, Treasurer; J. H. Moody, of Boston, General Manager; L. B. Baker, Chief Engineer. Arrangements have been made to begin work in sixty days.

AUGUSTA, Ga., May 2.—An enthusiastic meeting of prominent capitalists was held in Hussar Hall this evening, to consider matters pertaining to the new railroad which is to run from Augusta to Gibson and Sandersville, Ga. The contract for building the road has already been let to responsible parties.

WICHITA, April 27.—Bond elections were held yesterday in Union and Greeley townships, in this county to vote aid to the Wichita, McPherson and Denver Railroad Company. Bonds in the sum of $50,000 were voted in each township. The vote stood four to one for the bonds. A corps of engineers will at once begin work on the line through the townships.

THE Joliet Ill., Aurora and Northern R. R., has been incorporated. The principal office is to be at Joliet. Capital stock $2,000,000. Incorporators, Henry H. Evans of Aurora, Erwin E. Wood of Chicago, Daniel Robertson of Joliet Daniel H. Newton and James S. Newton of Holyoke, Mass. The same persons are also the first board of directors of the company.

JEFFERSON CITY, Mo., May 3.—Articles of association of the Springfield and Northern Railway company were filed in the office of the Secretary of State to-day. The capital stock is $1,000,000, divided into shares of $100 each. The proposed line of this road is from the passenger depot of the St. Louis and San Francisco road in North Springfield to a point one mile west of said depot, thence northwesterly through Greene and Polk counties to the city of Bolivar, a distance of about forty miles. The incorporators are C. W. Rogers, A. Douglass, Joseph Dun, G. W. Call, D. Wishart, Alexander Grayson, all of St. Louis, and John Oday, E. D. Kenna, E. T. Robertson, J. W. Straiglon, R. T. Hobert, Charles E. Harwood and D. H. Nicholas.

VINCENNES, Ind., May 2.—About a year ago Vincennes and Harrison townships, in Knox County, Indiana, voted $110,000 in aid of the construction of the Vincennes and Ohio River railway. The legality of the election was contested and, a few days ago, the Supreme Court decided in favor of the railroad. The company will hold its annual election in Vincennes May 6, when arrangements will be made to begin work. The road is designed to run from Vincennes to Jasper, a distance of sixty miles, over a continuous deposit of coal. Louisville capitalists, if this is successful, will begin at the other end and meet the Vincennes road at Jasper, part of the road having been graded a few years ago for a now defunct corporation.

C. P. R. EXTENSION.—The Ontario & Quebec Railway company has decided to commence the survey of the new line from Smith's Falls Ont., to Montreal at once, and to commence the construction as soon as the survey is completed. This branch will be the longest tangent in America, if not in the world, and will be a perfectly straight line from end to end. The longest tangent in Canada at present is the Canada Southern branch from Essex Centre to Windsor, and it is stated that if a cannon is fired from any point along the line towards either end the shot will fall in the centre of the track. This, however, is only sixteen miles, whereas the line from Smith's Falls to Carillon will be seventy miles long.

WOODEN BLOCKS IN FROGS.—The Boston and Albany Railroad Company are putting wooden blocks in the angles of all frogs and between the second rails of all switches on their lines to prevent loss of life among their brakemen. The blocks are low enough to allow car wheels to pass over them without striking, but high enough to prevent the possibility of a brakeman catching his foot while switching cars. About one-half of the line is now so equipped, and the remainder will be finished in a short time. The cost of the work is small, and the annual saving in lives and limbs of railroad employes will be great. The methods of putting in the blocks used by the Boston and Albany Road is the invention of their trackmen, and has been adopted by several other railroads. A bill is now before the Legislature of Massachusetts forcing the protection of all frogs and switches in this manner.

TEN MILLION CAR-WHEELS.—"There are more than ten million iron car-wheels in use on American railroads," said the master mechanic of one of the trunk lines, "and it requires about 525 pounds of iron to make one wheel. About 1,250,000 wheels are worn out every year, and the same number of new ones must be made to take their places. The iron men are called upon for only a small proportion of the 312,500 tons of material required for these new wheels, however, for nearly 290,000 tons are supplied by the worn out wheels themselves. Formerly the life of a car-wheel was estimated at eight years, but the reduction of the railroads generally to the standard guage, and the improvements in loading and unloading facilities, have materially decreased the length of service that a wheel may be depended on to perform. The uniformity in guage keeps cars in more continuous use, while the decrease in time of loading and unloading enables them to be put to more active service, even when they are run only on short local routes. These figures do not include the wheels on palace coaches, and the better class of passenger coaches. The wheels on that grade of rolling stock are now made almost exclusively of paper. They are as serviceable as iron, and combine lightness with strength, a great desideratum where speed and economy in motive power are of paramount importance."—New York *Sun*.

GLAD HE HAD SOMETHING LEFT.—The following amusing dialogue occurred during the discussion of the Barry railroad bill before the California Legislature. The question under consideration was the right of the State to exercise authority over the property of private corporations:

Senator Cross—Suppose, Mr. Barry, I buy a strip of land 100 feet wide and forty miles long, to whom does it belong?

Mr. Barry—To you, of course.

Senator Cross—And suppose I spend my money to set men to work grading until the strip is leveled to form what I call a road-bed, does it still belong to me?

Mr. Barry—Certainly.

Senator Cross—And suppose I buy ties and lay them down, and then buy rails and fasten them on the ties, it still belongs to me?

Mr. Barry—Yes, sir.

Senator Cross—Then suppose I buy some cars and locomotives and put them on the track, and let them stand there; does the property still belong to me?

Mr. Barry—It does, sir.

Senator Cross—Now, suppose I put water in the boiler and fire under it, and start to run my own cars on my own track, and take passengers on board, who does the property belong to?

Mr. Barry—Just as soon as you begin to carry passengers the property belongs to the public, all except the rolling stock, which belongs to you.

Senator Cross—Suppose instead of steam I use horses?

Mr. Barry—The same thing is true.

Senator Cross—To whom do the horses belong?

Mr. Barry—They belong to you.

Senator Cross—I'm glad I'm going to have something left out of my investment.

LONG TRAINS.—It is claimed that the longest train ever hauled consisted of 132 empty cars, one loaded car, a dead engine and two caboose cars. It was 6,200 feet long, and was run on the Pennsylvania road between Clark's Ford and Sunbury.

The above paragraph, published about a fortnight ago in the *Herald* and republished recently in the *Leader*, attracted the notice the other day of Passenger Conductor Shields, of the Lake Shore road, who said: "That isn't a circumstance to a freight train that I ran into Toledo several years ago. It consisted of 157 *loaded* cars, which were pulled by the engines Cleveland and Lucas. Engineer Oliver Dunbar, now master mechanic of the Wheeling & Lake Erie road, run the former, and John Vizier, now engineer of Engine 154, between Cleveland and Toledo, ran the Lucas. I presume that I ran the longest passenger train ever taken into Toledo. It was during the State Fair of about the year 1869. The train consisted of forty-four loaded coaches containing about 4,000 persons and pulled by one engine, the Ironsides, run by John Searles, now engineer of locomotive 157 on the Toledo Division."—Cleveland *Herald*.

SNUFF FOR INVESTORS.—The following flash at the Union Pacific management is from the *Wall Street News*:

Scene in a railroad office:

"Mr. Secretary," says the President, "have you prepared the advertisement asking for bids for the construction of 200 freight cars?"

"I have."

"Did you include 14 new locomotives?"

"I did"

"And 80 flat-cars?"

"Yes, sir."

"And 300 tons of steel rails?."

"Yes, sir."

"That's right; but while we are about it, we might as well ask contractors to figure on six new bridges and three or four station houses.' The next day the force is cut down 10 per cent. wages reduced fifteen, and the engineers have their oil measured out by the spoonful.

FROM SMALL BEGINNING.—In 1844 the Old Colony Railroad was chartered to build a short line out of Boston. The capital was fixed at $100,000, divided into 1000 shares.

From this beginning it went on year after year adding branches and taking in roads, until now it is made up of what was once twenty different roads. In every case when they have taken in a branch each one has become better and stronger financially. This corporation now has a capital and debt of $18,000,000, created by the union and consolidation of twenty different railroads. Its mileage in this Commonwealth foots up 475 miles. It has over 6000 different stockholders. It pays and has paid to these stockholders seven per cent. dividends. Were it to be reproduced to-day it

would cost $30,000,000. It actually cost $24,000,000. Out of twelve counties in this State its tracks enter seven. Out of twenty principal cities it connects with seven. It accommodates one-third of the entire population of the State. Its water frontage makes up 73 per cent. of the entire water front of the harbors of this Commonwealth.

Contracting Miscellany.

EL PASO, Texas, will build, at once, a $110-000 Court House.

DIMMITT COUNTY, Tex., is preparing to build a new jail.

TROY, O., will at once proceed to build its $150,000 Court House.

L. P. & J. A. SMITH will do the city dredging work for Cleveland, O., this summer.

WALDEN, Mass., has voted to have a new $30,000 school house.

J. R. MCDONALD, a Denver contractor, will superintend the construction of the Arcade railway under Broadway, N. Y.

OHIO is preparing to build an Intermediate Penitentiary. Bids for location are being received up to July 15th. The Chairman of Board of Managers is F. M. Marriott, Delaware, Ohio.

A PROPOSITION will be laid before the Northern Pacific directory, at the meeting May 8, for the construction of a railroad, 140 miles long, from Medora to Deadwood, Dak.

THE Board of Improvements of Cleveland, O., has a contract with Philip Platten for laying stone flagging for the ensuing year, at 13 cents per square foot rock-faced stone flagging, and 15½ cents for crandled and sawed stone flagging.

AT a meeting of the N. Y. Dock Commissioners on the 7th, the sealed proposals for building the new pier and removing the present one at the foot of East Twenty-sixth street were opened, and the contract awarded to James D. Leary for $32,390.

THE N. Y. board of aldermen on the 5th, passed an ordinance limiting the height of new buildings to sixty feet on streets less than sixty feet wide, and to seventy feet on streets of greater width. It is thought to be a severe blow to the building inte ests.

BIDS for the inside marble work, principally the floors, wainscoting, and stairways, at the new Cincinnati custom-house were opened at the office of the supervising architect. There were but three bidders, all Chicago firms, as follows: Sherman & Flavis, $72,200; Davidson & Son, 70,000, and the Burlington Manufacturing company, $66,000. The latter, being the lowest bidders, were awarded the contract.

SOME important results have been brought about by the committee of business men appointed by the Merchants exchange relative to the construction of a new and important railroad from Dallas Texas, but all the arrangements are not yet sufficiently completed so that information can be given the public through the press. Enough, however, is known to say that a charter will shortly be filed for the building of a road, with plenty of capital back of it.

AMONG recent contracts by the McDermott & Berea Stone Co. have been the following: Omaha, new court-house, 30,000 feet; St. Louis, new exposition music-hall building, 20,000 feet; Minneapolis, new hotel, 20,000 feet; Traverse City, Mich., Northern Michigan insane asylum, 20,000 feet; Lima, O., new court-house, 40,000 feet; Sidney, O., new court-house, 25,000 feet; Marion, O., new court-house, 30,000 feet; Columbus, O., custom house and post-office building, basement (super-structure not yet let); Jackson, Miss., post-office; Ionia, Mich., new court-house. This company also have contracts for the stone for several fine blocks and residences which are to be erected in Denver, Col., Richmond, Va., and Raleigh, N. C. They ship from 15,000 to 20,000 car loads of building stone, flagging and grindstones per year from their quarries at Berea, O.

Bridges.

THE wooden bridge over the Schuykill River at Royersford, Pa., was burned on Saturday morning. Loss $8000. An iron structure is to be erected.

THE bridge built across White river at Rockford, Md., in 1870, at a cost of $23,500, has been condemned by the county commissioners as being unsafe. A new bridge will be built in its place soon.

WASHINGTON, May 1.—The Senate District Committee held a special meeting to-day to consider the free bridge question. The representatives of the Aqueduct bridge lessees were present, and argued in favor of the purchase of the piers of that bridge. The committee agreed to report a bill directing the purchase of the aqueduct piers for $125,000, provided that a perfect title can be secured within ninety days, and, failing in this, authorizes the construction of a bridge at the Three Sisters for $220,000.

AN EXPENSIVE BRIDGE.—In 1868 the town of Westport built a truss drawbridge across the Saugatuck river, at Saugatuck, after a long series of quarrelsome town meetings and law suits, in which the Saugatuck Bridge company was a prominent factor. The contract was taken by A. D. Briggs & Company, of Springfield, Mass., to construct a truss bridge on piers at a cost of $22,500. The structure was completed in 1869 and opened for public travel. The entire cost, including law expenses, touched $30,000. The bridge is now scarcely passable for teams with safety.

B. H. Hull, C. E., of Bridgeport, Conn., has made a recent examination of the structure and reported in favor of a new bridge.

A town meeting has been held and a committee appointed to investigate the old bridge and procure plans for the building of a new one, which has been adjourned to May 10, at which time it is hoped that the town will decide that the average cost of maintaining public travel over Saugatuck bridge shall be at a less expense than $2,000 per year.—*Bridgeport Standard.*

Streets, Drainage, Sewerage, Etc.

COUNCIL BLUFFS will issue $100,000 in bonds for paving intersections of streets and alleys.

DES MOINES will build several miles of sewer this season and extend its water mains.

RAINS County, Tex., has let a contract for the building of a $12,000 court house on the public square at Emory.

J. J. GIBSON, of Marshall, Tex., will build a $26,000 court house at Center, Shelby County, Tex.

THE commissioners of Delaware County, Ind., have contracted for a new court house. It will cost about $200,000.

THE contract for the drainage, plumbing and gas fitting of the Randolph Company's Apartment House, Nos. 12 & 14 West 18th st., Mr. T. M. Clark, of Boston, Architect, has been given to the Durham House Drainage Co., of New York, at their bids of $9,702.

B. H. HULL, Civil Engineer of Bridgeport, Conn., is at work on the survey and plans for a system of drainage for the village of Stockbridge, Mass. A small drainage system was commenced last year which failed to work satisfactorily. At a recent town meeting a committee was appointed to secure the services of a competent engineer, and Mr. Hull was selected as the right man for the work.

BIDS were opened in Chicago, Ills., for building sewers on Kedzie avenue, Armitage avenue, and Robey street. The lowest bidder for the first named work was John Lyons, whose bid was $55,610; for the second named Martin McNichols, $33,750, and for the latter John E. McNichols, whose bid was $16,238. The awards will be made as above, and the work will be commenced at once.

PATENT SEWER SYSTEM 236,740—Sewerage and Draining Cities.—George E. Waring, Jr., Newport, R. I., assignor to the Drainage Construction Company, Boston, Mass. Filed July 17, 1880. (No model).

Brief.—Sewer pipes are smaller than and independent of storm-water system. Soil-drainage is combined with them in the lower and "filled in" localities. At the ends of the branches automatic flushing tanks are arranged. Jun tion of branch and main are by a tapering section to deliver the sewage to the bottom and draw the air from the top to the main. House connections are without traps, and the soil-pipe is run up through the roof for ventilation. Air inlets, boxed and grated, are arranged at intervals. A swinging section is arranged to deliver the sewage to either of two discharges. Plank piles, pointed at the lower end and notched at the upper end, are used to support the pipe in wet, loose soils.

In the Record for 1883 the following was found:

278,839—Sewering and Draining Towns.—George E. Waring, Jr., Newport, R. I., assignor to the Drainage Construction Company, Boston, Mass. Filed June 7, 1882. (No model.)

Brief.—The sewers are constructed to exclude storm-water. Automatic flush-tanks are connected with the branches for cleansing the sewers periodically and inducing ventilating currents through the pipes and house connections. The joints of the pipes are wrapped with a strip of muslin or similar material.

WESTMINSTER, MD., has shown true enterprise in determining to pave her streets. There are few cities of her size in this country that are so fully equipped with municipal safeguards and comforts. With a population of only about 3,500, she has a full system of waterworks, a swell fire department, a big opera house, and now she is going to add paved streets. In this latest improvement there is special cause for congratulation, since it will do away with that penetrating and adhesive dust which is one of the few sad characteristics of the county seat of Carroll. Westminster is pushing ahead rapidly, and her progress is all the more commendable because it is the result of home enterprise.—*Baltimore American.*

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, May 8, 1884.

The market conditions in the leading iron centres of Pennsylvania show no change from those reported last week. Manufacturers and brokers are talking of probabilities. Iron founders throughout Pennsylvania, New York and New England, are consuming more iron than they are given credit for; this fact is shown in the furnace statistics, from which it is evident that there is no accumulation of stocks, and very little change in price. Founders are purchasing from week to week, in a retail way, and the demand is sufficient to keep prices firm at $20, $19 and $18, for 1, 2, and 3 irons. Some of the larger consumers are willing to make speculative purchases in case a general strike takes place in the west. Eastern Bar mills are very short of orders at present, and very little can be said as to the summer requirements, unless there is trouble west of the mountains. Best Merchant Bar, in small lots, sold to-day at 2c. Best Common sold at 1.80; average price, 1.90c. Lots average from 5 to 20 tons. 4 or 5 fair bridge orders were booked within 2 days. 2 or 3 large blocks of Bessemer iron were ordered. About 1,000 tons of old rails, in all, have been sold, and there are inquiries for more than the market can supply, but not at asking prices. $21@$21.50 is offered. The lowest prices heard of for Steel Rails are $33. There are prices in hand at $32. Heavy purchases will be postponed until midsummer. Current requirements are for lots ranging from 100 to 500 tons each.

PITTSBURG May, 8, 1884.

All interest centres in the probable lockout. Manufacturers keep close counsels. The workmen are doing the same. Some manufacturers are in good shape for a summer's shut down. There are fair stocks of iron on hand, but the outcome of the negotiations is uncertain. Common Iron ranges from 1.60 up: refined, 1.75 up in small lots; large orders could be had at something less. The Structural mills are full of work. Plate and Sheet mills have been taking a good many orders since the first of the month. There is a fair demand for Boiler Iron. The Park Bros. are receiving heavy orders for their Steel Plates. The Carnegies are reporting heavy demand for Structural Shapes. The Oliver Bros. have shut their 3 big mills down. The nail men have not fixed matters up as yet, and although it is given out that the pool arrangement will be perfected, it is not safe to rely upon the statement.

CHICAGO, May 8, 1884.

Matters continue rather dull in the northwest. If there is any activity beyond the ordinary run, it is in Ingot Copper, Copper Sheets, Stamped Tinware, Barbed Wire and heavy Hardware. Boiler Steel is under active inquiry. Steel Rail Mills are running short of orders at $35@$36; large orders are seldom heard of. There is very little activity in Russian or Planished Irons; Common Iron, 1.90 @2c. Lake Superior Charcoal Iron, $22@$24.50 from Nos. 1 to 4; Alabama Coke Irons, No. 1 to 2, $19@$20. Very little is done in Foreign Irons. Several furnaces will blow out during the month, in this region, unless business soon improves. Nails, $2.50 in car load lots.

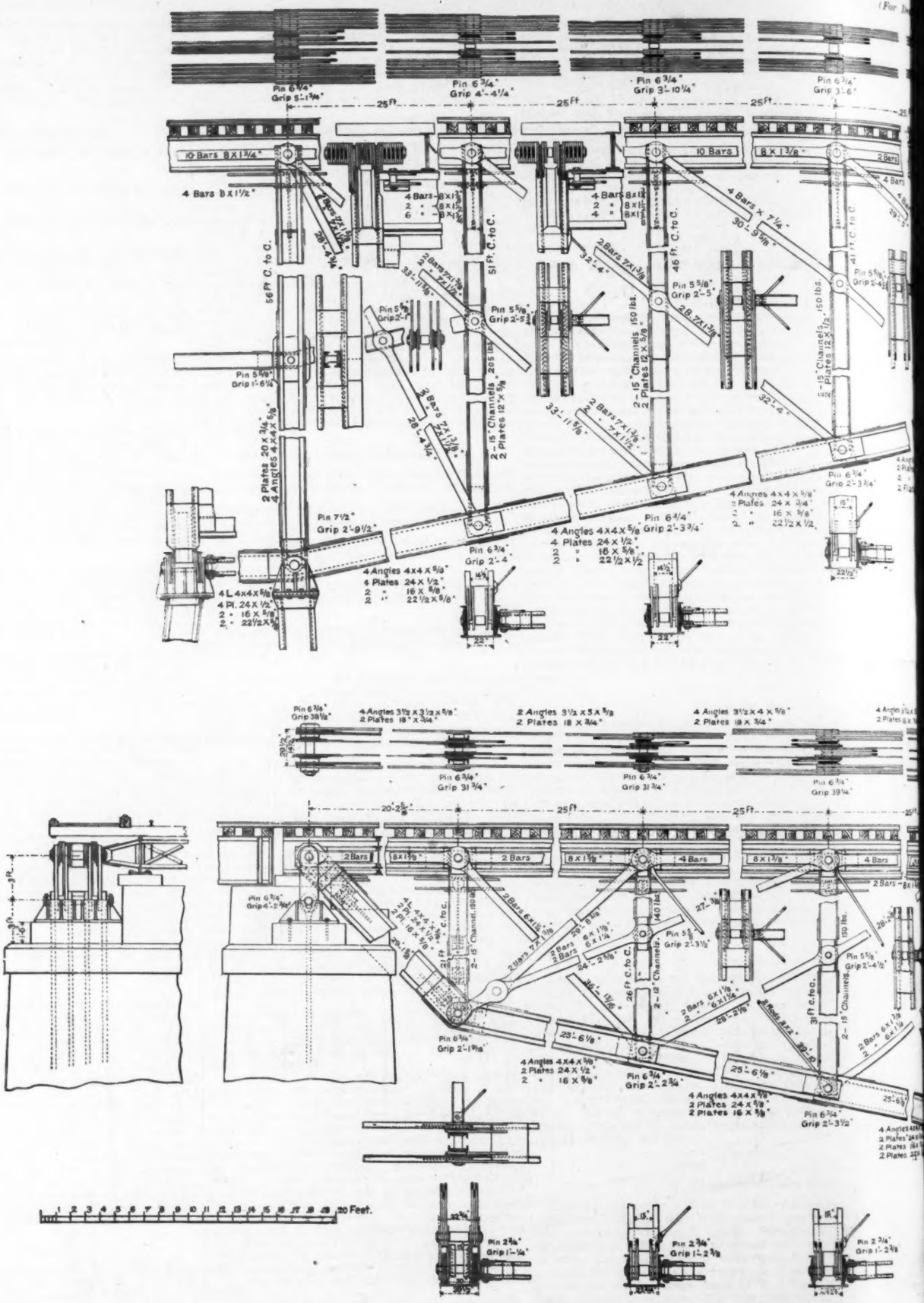
COAL.

PHILADELPHIA, May 1, 1884.

Those who have been looking for a heavy demand in Anthracite Coal, have been disappointed. Stocks have been increasing at Port Richmond, notwithstanding the restriction. There has been considerable shading of prices, and it now seems probable that a further restriction will be necessary, if prices are to be held up. Vessels are arriving more freely at Port Richmond. Large shipments are expected to take place during the next 60 days, to Chicago, Milwaukee, and other western ports, via. Buffalo. A few good contracts have been placed in southern markets. The Bituminous trade is in better shape. The shipments to New England ports are increasing. Shipments from the Clearfield and Cumberland regions, are growing from week to week. A general shutting down has taken place on the Monongahela. The territory, shipping to lake ports, is being worked more freely to fill large railroad contracts placed a month ago.

THE NIAGARA

DESIGNED BY C. C. SCHNEIDER, M. AM. SOC. C. E., CHIEF ENGINEER



NTILEVER BRIDGE

R BRIDGE CO. THE CENTRAL BRIDGE CO., OF BUFFALO, CONTRACTORS.

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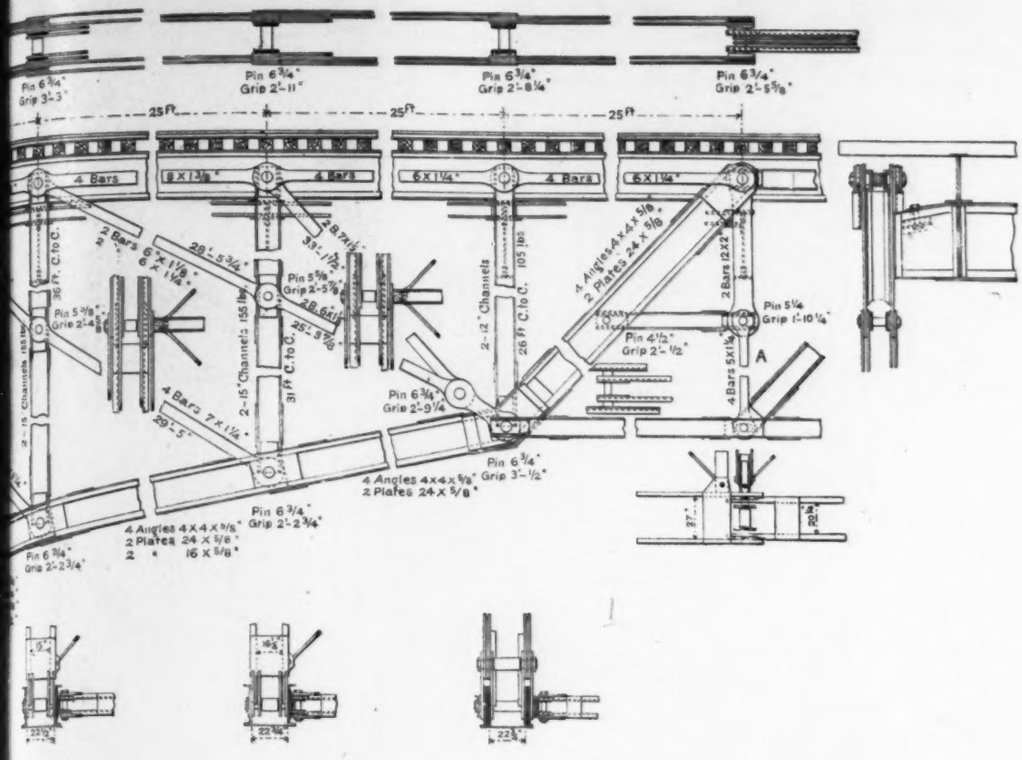

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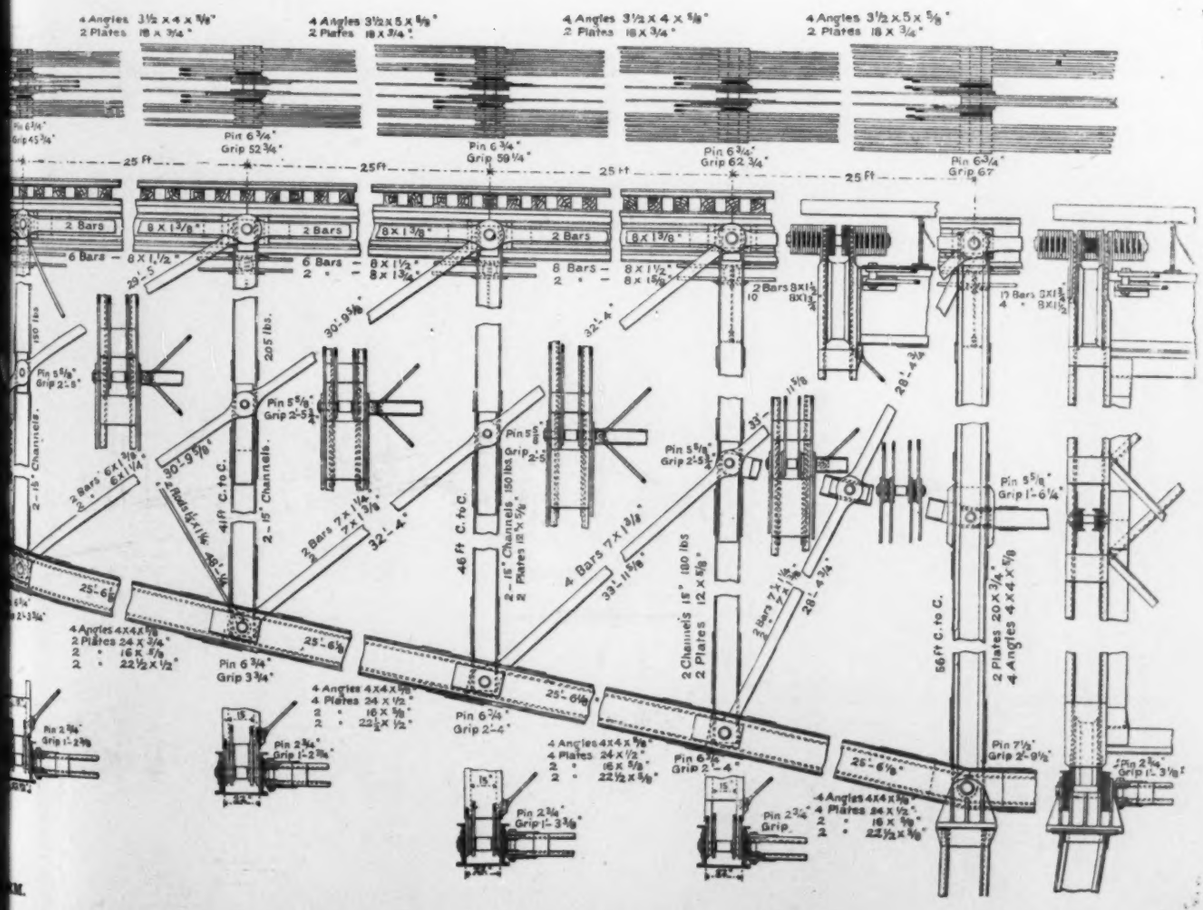
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Pin 6¾" Grip 45¾"
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Pin 6¾" Grip 59¼"
Pin 6¾" Grip 62¾"
Pin 6¾" Grip 67
25 Ft.
25 Ft.
25 Ft.
25 Ft.
2 Bars
8 X 1⅜"
6 Bars — 8 X 1½"
2 " — 8 X 1¾"
29'-5"
30'-9⅝"
32'-4"
2 Bars 8 X 1½"
10
28'-4¾"
17 Bars 3 X 1¾"
4 " 8 X 1½"
150 lbs
205 lbs.
Pin 5⅝" Grip 2'-5⅝"
2 Bars 6 X 1⅛"
2 " 6 X 1⅛"
41 Ft. C. to C.
2 - 15" Channels
2 Bars 7 X 1⅛"
2 " 7 X 1⅜"
46 Ft. C. to C.
2 - 15" Channels 180 lbs
2 Plates 18 X 5/8"
4 Bars 7 X 1⅜"
33'-11⅝"
2 Channels 15" 180 lbs
2 Plates 12 X 5/8"
3 Bars 7 X 1⅛"
2 " 7 X 1⅜"
28'-4¾"
56 Ft. C. to C.
2 Plates 20 X ¾"
4 Angles 4 X 4 X 5/8
Pin 5⅝" Grip 1'-6¼"
Pin 7⅛" Grip 2'-9½"
4 Angles 4 X 4 X 5/8"
4 Plates 24 X ½"
2 " 16 X 5/8"
2 " 22½ X ½"
Pin 6¾" Grip 3¾"
Pin 6¾" Grip 2'-4"
Pin 6⅝" Grip 2'-4"
Pin 2¾" Grip 1'-2⅝"
Pin 2¾" Grip 1'-3⅜"
Pin 2¾" Grip 1'-3⅜"
Pin 2¾" Grip
25'-6⅛"
25'-6⅛"
25'-6⅛"